THE

ELECTRICAL REVIEW.

VOL. XLV. OCTOBER 6, 1899. No. 1,141.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

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MUNICIPAL AMENITIES.

IT is very nice to theorise upon the advantages of municipal industry, and to think how much better off we are when electric light, gas, water supply, and tramways, are all in the hands of the local authorities; but, although there is much to be said in favour of such municipal development, yet a danger also exists of painting these local industries in colours of too bright a hue. Disillusionment is certain to follow, and a consequent set-back to any progress in this direction—whether such progress be really advisable and wise or not.

The financial aspect of municipal electric traction will not disturb the bigger towns and cities, but it may well do so with the smaller ones; and the question of intercommunication between adjacent towns or centres will prove even more important, for the only possible means of municipal working in such a case, viz., that of a joint committee, is beset in practical daily working with such enormous difficulties that the operation of electric tramways by local authorities (unless with systems or networks absolutely isolated in single areas) is likely to utterly fail for this very reason.

Endless jealousy of one another is always felt by neighbouring authorities, and too often the big one tries to override the smaller, or play the big boy and the fag.

Take, for instance, certain authorities in the North, one of which, the larger "A," has already electric tramways at work. The smaller district, "B," sends a deputation to ask whether "A's" lines can be extended into "B's" district far as the Town Hall. "A" replies: "They cannot enter into a partnership with 'B,' nor give 'B' the option of purchasing the lines and cables, but would obtain electric energy from 'B' if they ('A') found it advantageous to do so."

This stands out as a cheeky piece of monumental bluff, if truly reported, and the small authority, "B," has only to wait until such time as "A" wants to come outside its district and asks Parliament for powers. "B" will then find that a Parliamentary Committee will support it ("B"), even preferably to the bigger authority, and give it permission to purchase such tramways on more favourable terms than are even mentioned in the iniquitous Tramways Act of 1870.

But how truly absurd it is for one authority to so attempt to override a smaller one! Every additional branch line reaching out like the one sought for by the small authority, is a feeder to the trade of the big town, and deserves every possible encouragement; and for the town to pose as the benefactor instead of the one who profits, is as ridiculous as it is shortsighted.

The same tendency has been noted in other places; and one city in particular has sufficient self-conceit to lay down, as a condition of taking the tramways outside the municipal boundary, that it shall be given control of, or a right of, tramway, over the neighbouring districts, roads and streets, *for ever*.

We cannot believe that this assignment in perpetuity of any rights there may be of running electric tramways along the roads, has received the full consideration by Parliament that it should require before approval. The confiscation of roads for traction purposes in this way by local authorities is quite as unjustifiable as if it were done by an individual; and if a right of way is limited in period for private interests, there seems no reason why, inherently, the same kind of monopoly should be granted to a public body for ever.

Our Industrial Supremacy.

It is gratifying at times to read in some of the more reasonable American trade journals appreciative notices of the splendid performances which are written down in the history of English engineering work. In several recent issues from across the ocean we have observed that journals of this class have administered sharp rebukes to some of their lower class contemporaries, which are for ever shrieking about the declining supremacy of poor old England. The object of these shrieks is, of course, to enable them to bring into greater relief the very wonderful things which are being achieved on their own territory. No one is more ready than ourselves to give due credit to America or Continental countries whose progress during recent years has taken a quicker pace than our own, but the scare has been absurdly overdone. We have frequently admitted, with candour, that we are behind our trans-Atlantic rivals in some things, but in following the comments of some of these irresponsible critics whose opinions unfortunately obtain currency bearing the appearance of authoritative views, the casual reader is persuaded that this poor old country's industrial constitution is in a state of rapid decay, in fact, almost beyond hope. Of course, those who are acquainted with the facts of the case know how to treat these ridiculous fabrications. We know that, generally speaking, English factories and works never were so busy as they are to-day, our colonial and foreign trade never was so large, and our reputation for good, substantial and thorough work never was better; all over the country new works are springing up and old ones are being extended—in short, everywhere there are signs of increasing prosperity. Some of our foreign rivals are, we willingly concede, rapidly adding to their reputation for quick, and perhaps, cheap, work. There appears to be a fair field for construction of this class, in spite of the fact that some of the cheap and quick work turns out to be very dear and very slow in the long run. But taking a general purview of the situation, where does the blame lie for our apparent backwardness? We have on several occasions brought it home to the handicapping influence of labour. In the praiseworthy endeavours which have been put forth to improve the condition of what are called the "working classes," they have been given an inch and they have taken the proverbial ell. It has been frequently asked of late to what extent American manufacturers who establish works on English soil will be troubled by the many phases of the labour problem as it exists to-day. When these Jonathan-Bull works have been running for a time it will be an interesting occupation to compare the experiences of the works in England and America respectively, with a view to calculating the effect of labour upon these new factories and their outputs. At the moment of writing there is before us a note of the views of a leading United States fiscal expert and statistician—the Hon. Robert T. Porter—who has been interviewed by some enterprising pressman anxious to obtain his opinions on trade matters. The Hon. Porter is reputed to have expressed the opinion that England has not lost ground in the World's markets, and that with the aid of technical education we are making efforts to keep pace with the increasing skill of our rivals. But like anyone else who reads the outlook aright, he apprehends the possibility of evil consequences, if the excessive interference of trade unions is permitted to continue. While advocating, as we ourselves have also done, organisation, of a kind, among the working classes for certain purposes, he deprecates the tendency to dominate the master in the conduct of his business. One of the largest electrical appliance manufacturers in the States is reported to have stated that he could not possibly carry on his establishment, if he had to submit to the dominance of British trade union regulations. Mr. Porter attaches great importance to the use of automatic machinery as a means for enabling the employer to once more gain complete command of the reins.

From these few brief notes it is apparent that Mr. Porter's views are quite in keeping with those of common sense practical men in this country. He has at once placed his finger upon the weak spot in our industrial life. The pity of it is that those who are responsible for the evil are apparently blind to their own interests.

Gas v. Electricity.

The *Gas World* says that notwithstanding all the pushing of electricity in Edinburgh, the consumption of gas increases at a remarkable rate, and the writer quotes figures for the month of August giving support to the statement. The concurrent advance of gas and electricity in various towns is a matter of common knowledge, but what we cannot understand is why gas interests should so obstinately and obstreperously do all in their power, by means both fair and foul, to keep electricity schemes in abeyance. Upon their own showing, where electricity is introduced the gas supply increases. Why, then, oppose it? Gas suppliers have a splendid field at present in the rapidly extending use of gas for domestic heating purposes, a business for which electricity is not yet able to cater at a reasonable price, at any rate with a view to meeting the requirements of the average consumer. Where electricity is to reveal its advantages and to reap big profits in the future, is in the extension of areas supplied with energy for lighting and motive power purposes. The small gas engine has done, among other things, a useful work in educating the small manufacturer up to the benefits following a cheap supply of motive power, but it is being rapidly supplanted by the more convenient electric motor wherever a public supply of power is available. The great future for gas engines, so far as the electrical world is concerned, seems to be in the driving of large electric generators, but as we have often said, the electric motor is proving itself a remarkable boon to the small man for his thousand and one operations for which power is needed on a limited scale, and what it now does is but a small indication of the great proportions which the power supply business will assume in due course if proper attention is bestowed upon its development by a policy of wise encouragement. We suppose there must come a time when the consumption of gas for purely lighting purposes will have reached its highest point—even if that time has not already arrived—but in domestic heating it may hold its own for a long time to come, unless some of these revolutionising inventions of which one hears at varying periods are going to improve the chances of electric heating.

Black Lists.—Our municipal contemporary *London* warns "negligent and unscrupulous contractors" that certain municipal authorities are now keeping a "black list" of those who "fail to carry out their contracts to the satisfaction of the Council." We do not deny that there may be contractors who are either negligent or unscrupulous, or even both, but perhaps it is as well to mention that there are certain reputable firms who keep their own black list of Councils which fail to exhibit any fairness in dealing when placing contracts. The Employers' Federation has a very long and very black list, showing pretty clearly the density of the municipal authorities throughout the kingdom. We have already drawn attention to this on several occasions for the benefit of electrical manufacturers.

NOTES ON ELECTRICAL SPECIFICATIONS.

By ERNEST KILBURN SCOTT.

SPECIFICATIONS are absolutely necessary in expediting large business transactions, and can generally be used with advantage on comparatively small contracts. It is true that when there is no specification, goods can often be bought cheaper, but the reasons for high quotations are:—

(*a*) The specification is not clearly drawn.
(*b*) The tests are too numerous or unnecessarily severe.
(*c*) The payments are too long deferred.

All reliable manufacturers are accustomed to making suitable tests, the severity of which is graduated in accordance with the importance of the article in case of failure. When, however, a number of special tests (which partake more or less of the nature of experiments) are asked for, it is only natural that a good round sum should be added to cover the extra work and risk. Specifications drawn up by professors are frequently troublesome in this respect.

Deferred payment, in which the final 10 per cent. is paid nine months after the plant is running (or at a time even more remote), is a favourite method with municipalities, who as they come by their money so easily ought to be the first to hand it over. It is an axiom in business, at any rate between individuals, that he who pays promptly gets best served. The 10 per cent. generally represents all the profit on the transaction, and it is no wonder, therefore, that the principal firms have one price for municipalities who dribble the payments over months and months of time, and another price for companies, shippers, and private individuals who pay up properly. If anyone doubts this let him ask a leading high-speed engine maker, who stocks the parts of standard sizes, for the price of a certain sized engine *with* and *without* the deferred payment clauses as they usually appear in municipal contracts.

A specification need not aim at being either a legal (the less the average town clerk has to do with it the better) or a literary production. Schedules, and plenty of them, are what contractors want nowadays, not wordy clauses.

Drawings.—Drawings are sometimes submitted with specifications, in fact an arrangement drawing forms a specification in itself. It is a mistake, however, to show too much detail, or at any rate to dimension such details. Nine times out of ten the dimensions will not fit the standard designs of the tenderer, or if they do, he may, from further experience, be able to suggest improvements.

Some engineers prefer to make original designs of various parts of the plant, as, for example, the switchboards, and this is all right in its way, but as it does not pay engineering firms to get out patterns and special jigs, &c., for work which they may never get another order for, the result is that few tenders are offered, and the work has to be put out at a fancy price. The cost of tendering for electrical work is a very considerable item of the establishment charges, and with plenty of work in their shops electrical firms are breaking off their old habit of sending in tenders for every job advertised.

Workmanship.—However lengthy or elaborate a description may be, it cannot be made to represent the character of the workmanship, and other ways have to be found of safeguarding this. If the contract is a large one it will probably pay for an inspector to sit over the work to see that a certain standard of workmanship is kept up. In the majority of cases, however, the makers' guarantee is accepted, such a guarantee taking the form of a written offer to keep the apparatus or machine, &c., in working order, allowing for fair wear and tear, over a definite period of time.

Steam Piping.—Steam piping is one of the most awkward things to estimate for, and an alteration to any part of the plant, as, for example, a different type of feed pump, may make a considerable difference in price. Many firms have regretted taking pipe contracts because of the large amount of expense to which they have been put in erection, and the writer's opinion is that the erection should always be done by day work. If, however, those who employ the engineer insist, as municipalities usually do, on having a complete tender, they must in future be prepared to pay through the nose to cover a very large contingency item. The actual amount which the contractor may think it advisable to add on for contingencies will depend on how detailed the consulting engineer makes his specification and drawing. By detailed the writer does not mean giving the exact thickness of the flanges, the number and diameter of bolts and that sort of thing, but indicating clearly the pipe chases, the number and exact position of bends, the connections of the feed and drain piping, approximate positions of relief valves, steam-traps, water meter, feed pumps, water heater and exhaust to atmosphere. This is the information the contractor requires, but which is seldom given properly. It is common knowledge that even the best consulting engineers' specifications go thoroughly into trivial details, and omit or only casually refer to what is really important, and this is especially the case with the piping.

Vague Specification of Output.—Specifying two or three voltages for dynamos which have to be used for charging accumulators as well as lighting direct, is especially troublesome. In a recent specification three voltages were given, the difference between the highest and the lowest being about 40 per cent. There appears to be a sort of hazy idea abroad that a dynamo will not be any larger or more expensive if two voltages are specified. This is, of course, wrong, as the designer simply works by the maximum voltage and the maximum current, making the field to suit the former, and the section of the armature conductors to suit the latter. To cut down the field current and work the machine at an inefficient and unstable point most of the time (when not charging batteries) is a poor sort of makeshift for a central station, but in case it is preferred to having a booster, then the charging current at the higher voltage should be distinctly specified as well as the maximum current at the lower voltage. If the charging current is very small, say one-third of the maximum current, then something may be gained on account of the drop in voltage of a shunt machine, and if the engine will allow of it advantage may also be taken of an increase in the speed. This information is, however, seldom given, and in its absence the dynamo maker can only be safe by quoting a machine which will give the maximum current and maximum voltage at constant speed.

Temperature Rise at "Full Load."—The words "full load" are frequently used in a loose sort of way. What, for example, is the full load of a dynamo specified to have several voltages as mentioned above? At the high voltage the field will get hot, while at the low voltage the field will be cool and the armature hot. Although not always wanted, the writer thinks it would be an advantage if, when specifying the temperature rise after a certain number of hours' run, consulting engineers and others would distinctly state the *load in amperes and volts* instead of simply saying "at full load."

Speed Variation.—The variation of speed of direct coupled sets has been a stumbling block in one or two cases. For example, in a recent contract, the specification required an alteration of speed of 10 per cent. above or 10 per cent. below the normal. Now, although governors are capable of some wonderful things, this is outside their powers. It should be remembered that when altering speed by screwing up or unscrewing springs the sensitiveness of the governor is increased or diminished respectively, and either hunting is caused by increased sensitiveness, or, on the other hand, too great a range of speed is permitted through decreased sensitiveness. If a long range in the variation of speed is required for synchronising or other purposes, it can only be attained at the expense of the governing properties.

Short Circuiting Test on Alternators.—In some specifications alternators are required to withstand a short circuiting test through a seven strand cable (whatever that may be). Now, most iron-cored alternators will stand short circuiting, but why should the risk be taken at all? When a railway superintendent orders a new locomotive he does not insist that it shall be put to the test of a collision to see if it is strong enough.

Parallel Running.—Where alternators without iron in the armature already exist, a clause is inserted that the new alternators must run perfectly in parallel with the old machines, and although an iron-cored machine would apparently be preferred, the supplier of the new alternator is practically asked to indemnify the customer against any breakdown of the old machines. This, of course, cuts out the makers of ironclad types, as it is very certain which alternator would go in case of accident. Engineers who

have machines without iron in the armature must therefore go on using them to the end of the chapter or else withdraw this objectionable clause.

Transformer.—There appears to have been a good deal of reckless guaranteeing of late, with the result that figures are given in specifications which are simply unattainable by any transformer in the world. This is especially the case with the voltage drop and the magnetising watts. Contractors are asked what the latter will be in 12 months' time when, as a matter of fact, it is pure guess work, and it cannot be known what work the transformers will be put to in the interval.

Temperature rises of the larger transformers are more often than not specified at utterly ridiculous figures. The fact that the larger the transformer the less is the proportion of cooling surface to the watts lost, is overlooked.

Flashing or Insulation Test. — Flashing or testing the insulation by applying a high pressure for some time is often specified at an absurdly high voltage. The other day, for example, some dynamos which ordinarily worked at 440 were specified to withstand 5,000 volts or over 10 times the working pressure. The writer can understand that for the field coils of a tramcar motor a test at, say, 1,000 volts, is useful because of the great amount of self-induction from the magnetic blow-out, but for an ordinary central station dynamo such a high voltage as 5,000 is unreasonable. 5,000 volts is quite high enough for the primary coils of transformers which ordinarily have to work at 2,000 volts.

The high pressure stress is undoubtedly the one to make (plugging for megohms on a bridge is waste of time except as a rough guide, when the stress test can be taken), but the writer would suggest that the stress test should be specified to be taken when the apparatus to be tested is cold.

Water Consumption Bonuses. — Bonuses for the steam consumption of direct coupled sets are an excellent idea, but some consulting engineers show themselves distinctly one-sided in specifying for same. To start with, a steam consumption is given which leaves very little chance for any contractor to escape being fined, and yet to make doubly sure that he shall not benefit, the figure under which the bonus can be earned is set much lower than the guarantee. Surely it would be only fair to fix one value with a bonus above and a fine below. As a rule where the engines are high speed, these tests can be best made at the engine makers' works, but when a test on site is insisted on, the contractors should be allowed preliminary runs to ensure that the plant has fairly settled down on its foundations and the bearings are properly in line. Where a very high efficiency is asked for it may take several weeks' running before the plant will give it. For high speed engines the steam consumption test might be specified per B.H.P.-hour, and be taken at the makers' works, whilst the combined efficiency of the engine and alternator or dynamo could be taken after several weeks' running on site. With the large slow running sets there is nothing for it but to erect on site straight away and test per KW.-hour by measuring the water into the boiler.

Delivery on Site.—With reference to the erection of the machinery, it would be an advantage to add a clause such as the following, to make it quite clear that the contractors are to have facilities for getting the plant on to its foundations:—It is understood that the railway company's wagon can bring the machinery directly under the overhead crane in the engine house, and that this crane will be available for lifting the plant on to its foundations. In case any extra work is required in preparing a road for the wagon, or getting the machinery under the traveller, or in case the crane is not ready the customer will either undertake the extra work or make an allowance to the contractor for doing it, at day work prices.

Insurance.—As it often happens that a good deal of valuable machinery is lying about at the generating station, it would be as well if the conditions specified exactly how far the contractor is liable in case of fire. He is, of course, entirely liable for the fire risks while the plant is in his own works, whilst the railway company takes over the liability during transit; it appears to the writer, therefore, that it would be only fair that the customer or corporation and the contractor should share the fire risk equally whilst the plant is in the customers' station or premises until such time as it is handed over. It has been specified that the policy is to be taken out in the joint names of the corporation and the contractor, and to be retained by the corporation. Surely the corporation should share in the risk.

Liquidated Damages.—It is now generally conceded that the maximum amount of damages on any contract should not exceed 1 per cent. per week of the contract sum, but cases still occur, as in the Glasgow traction contract, in which exceptionally severe penalties are imposed. As the contractor stands to lose orders if he gets the reputation of giving bad deliveries, the customer is well protected by 1 per cent. per week. It would, however, be better to make it clear in future specifications, that the 1 per cent. only applies to total contract sum when the whole of the plant is behind time. Thus, suppose 20 transformers were ordered for the sum of £2,000, and the first 10 delivered to time, and the second 10 one week late. Then, obviously, the 1 per cent. should only apply to the value of the second 10 transformers, *i.e.*, £1,000. This is a matter on which most specifications are particularly vague.

In the building trade these questions of damages have gone into the Law Courts many times, and the result has generally been that the contractor has won for the simple reason that he has easily been able to prove some deviation from the specification. A slight alteration will apparently nullify the most accurately worded clause. Even where the contractor has lost the case he has only paid an amount which covered the actual damage sustained by the customer, and in assessing such damages the wording of the penalty clause has been ignored. As a matter of fact, there is in legal circles a strong feeling against consulting engineers, architects, and others taking upon themselves the specifying of the damages in case of non-compliance with conditions. The words which have been added in recent specifications to the effect that the "penalty shall be claimed as ascertained liquidated and agreed damages" is supposed to put the matter right legally.

Fair Wages Clause.—This promises to be the cause of trouble in the future. In some clauses it is not clear whether the specified wages are to be paid to men employed on a particular contract or to all the men in the factory.

The latest form of clause reads somewhat as follows, and refers only to the contract in question:—

"That all workmen employed in carrying out *the contract* shall be paid at a rate of wages and observe the hours and conditions of labour as recognised by the Masters' Federation and the representatives of the men's trades unions for the district. These conditions shall also apply to sub-contractors."

"The contractors agree that the engineer for the Corporation shall, at all reasonable times during the progress of the works, have free access to the workmen of the contractors, and to the wage books of the contractors, and to the factories or other places which shall for the time being be in the occupation of the contractors for the purpose of this contract, and shall, on behalf of the Corporation, be entitled to make full inquiry with the object of ascertaining that the stipulations in respect of the rates of wages, and the conditions of labour are being duly observed by the contractors."

It would be rather difficult to say what men are and are not employed on the contract; thus the shop sweeper, or the stoker of a boiler in another part of the works where the packing cases were made, would be indirectly employed on the contract. The phrase that all unskilled labour is to be paid at the rate of 7d. an hour opens up questions of which it is difficult to see the end.

PROGRESS IN THE ACETYLENE GAS INDUSTRY.

By JOHN B. C. KERSHAW, F.I.C.

I.—Generation.

The genus—Inventor—still continues to find in the generation of acetylene gas from calcium carbide a fruitful field for the display of his abilities. The following figures show the numbers of patent applications relating to calcium carbide and acetylene *granted* during the last three and a half years:—

1896	...	...	159	1897	...	172
1898	...	...	177	1899, first half	...	101

The proportion of these totals which relate to furnaces for carbide production is very small, and by far the greater number of patents relate to generators and lamps.

The value of the majority of these patents is absolutely nil, the novel (?) methods of bringing the carbide and water into contact having been in use for years for the laboratory generation of such gases as sulphuretted hydrogen and carbonic acid.

This fact, however, does not in the least lessen the activity of the hosts of inventors engaged in elaborating apparatus for acetylene generation; in fact, it rather seems to stimulate them since it renders invention more easy. The writer has more than once referred to this subject, and he is pleased to note that his opinion as to the valueless nature of most of the patent acetylene generators is endorsed by others.*

However, a British patent, though lacking in novelty and of no intrinsic value, is often quite sufficient basis for a company promotion, when a "boom" in the special branch of industry with which it is connected is in progress, and acetylene patents have formed no exception to this rule.

During the last 12 months the following companies have been registered in this country alone:—

Name of company.	Authorised capital.
Buffington Acetylene Gas Light Company	£100,000
Freis Calcium Carbide Company	60,000
Carbides, Limited	50,000
Electroid Gas Company	50,000
Imperial S. C. Acetylene Gas Company	40,000
Carbides Development Syndicate	30,000
Read-Holliday Acetylene Company	30,000
Turr's Acetylene Gas Syndicate	25,000
Tyne Acetylene and Carbide Company	10,000
Home and Colonial Acetylene Syndicate	10,000
Acetylite, Limited	10,000
Carbide and Acetylene Trust, Limited	8,100
Patents Development Syndicate	5,000
Acetylene Purifying Company	5,000
Acetylene Manufacturing Company	3,000
Total	£436,100

Some of these companies are, no doubt, at present doing a profitable business by the sale and installation of their generators, but this fact does not prove that the patents they hold are worth the sums paid for them. The attention of investors in acetylene gas companies might with advantage be given to a recent article in the journal devoted to the industry, in which it is stated that some of the companies floated during the "boom" are already in the hands of the debenture holders.† The number of patents granted for acetylene generators, which the writer now estimates at over 600, ought to convince investors of the folly of paying large sums for such inventions. Patent acetylene generators promise to become as plentiful as blackberries in August, and therefore ought to be equally cheap.

II.—Purification.

The purification of acetylene gas is now receiving considerable attention from scientific investigators, and some valuable contributions to the literature of this subject have recently been published.‡ It was formerly supposed that the acetylene gas might be safely burnt as it came from the generator without purification, but it is now recognised that for domestic lighting and for public halls it is absolutely essential that some process of purification should be adopted. The chemicals that have been recommended and tried for this purpose are:—

(*a*) Lime water, by Lundstroem.
(*b*) Bleaching powder, by Lunge and Cedercreuz.
(*c*) Bleaching powder and lead chromate, by Wolff.
(*d*) Acid cuprous chloride solution, by Franks.
(*e*) Chromic acid, by Ullmann.

The first removes all impurities with the exception of the phosphoretted hydrogen, the most dangerous to health; it is therefore useless alone. The use of bleaching powder is condemned by Caro,* on account of the possible formation of nitrogen tri-chloride, and therefore only the methods of Franks and of Ullmann can be considered of practical value. The absorbents adopted in these two methods may be used in conjunction with powdered quartz, and these mixtures have been patented under the names of "Frankolin" and "Heratol" respectively. It is stated that 5½ grammes of chromic acid suffice to purify 1 cm. acetylene gas; but it is evident that the amount required must depend upon the percentage of impurities present. Caro recommends that the purified gas should be subjected to a final scrubbing action with paraffin oil, in order to remove any impurities picked up from the chemical re-agents.

In relation to this question of purification, Liebetanz, in his report upon the exhibition of acetylene generating and purifying apparatus at Buda-Pesth in the early part of this year, makes the following remark:—"It is to be urgently recommended that makers of acetylene generators should entrust the design of the purifying apparatus to those who have a special knowledge of the subject, for the purifying apparatus exhibited showed in many cases a complete ignorance of chemical knowledge on the part of the designer, and often formed a dangerous addition to the complete apparatus."† The ignorant inventor is therefore not unknown outside the limits of the British Isles.

III.—Utilisation.

The attention which has been paid to the scientific aspects of the generation and purification of acetylene has improved the practical value of the gas as an illuminant, and its use for this purpose has undergone considerable extension during the last 12 months.

The high price of carbide in certain districts remote from a producing factory, is, however, a considerable hindrance to the further extension of acetylene lighting, and there is no doubt that in many places where it has already been adopted, at the present price of carbide, it will be found a very costly illuminant. It is customary for those engaged in pushing the sale of acetylene apparatus, to urge the use of acetylene, because it is cheaper than coal-gas or oil, in the particular locality where they may chance to be operating. In numerous instances this is absolutely false, and such tactics will not conduce to the permanent gain of the carbide or acetylene industries. The *Progressive Age*, one of the American papers favourable to the acetylene gas industry, has recently‡ been commenting on this tendency to underrate the cost of the gas when dealing with prospective buyers of generating apparatus, and has referred to the distribution of pamphlets and leaflets, in which the ratio of cost between illumination by coal-gas and by acetylene is stated to be 4·2 : 1·0. The lowest ratio found in any of these circulars is stated to be 1·0 : 1·0, while the actual ratio calculated on the prices then current in New York was ·5 : 1·0, acetylene being twice as costly as coal-gas for equal illuminating power.

The dissemination of false information of this character has led to the discarding of acetylene in some cases—after actual trial. Thus the Canadian Electrical Association has recently made an inquiry concerning the position and prospects of acetylene lighting in Canada.§ It found that there had been 90 installations of acetylene apparatus, involving the operation of 217 generators; but that 62 generators, or over one-fourth of the total number, after a few months' trial, had been put out of use.

An anonymous writer in the *Engineer*‖ recently discussed this question of relative costs of acetylene and coal-gas, in a singularly fair and temperate article, and summed up by urging the general adoption of acetylene as an illuminant, on grounds—not of economy—but of health. Though in favour of the new illuminant, this writer was obliged to admit that as compared with coal-gas or oil, it was, in most places, *at present much more costly, and was likely to remain so.*

That there are localities where acetylene is cheaper than coal-gas is, of course, true, and the correct policy of the Carbide and Acetylene Companies is to seek out these, rather than to direct their attention to districts where coal gas or

* The *Engineer*, August 25th, 1899. *Journal Acetylene Gas Lighting*, May, 1899.
† *Journal Acetylene Gas Lighting*, January, 1899.
‡ *Journal f. Gas Beleuchtung*, 1899, p. 198.

* *Zeit. f. Angew Chemie*, July 11th, 1899.
† *Ding'er's Polyt. Journal*, June 10th, 1899.
‡ *Progressive Age*, April 1st, 1899.
§ *Lightning*, August 31st, 1899.
‖ The *Engineer*, March 31st, 1899.

electricity are in the stronger position. In such localities, oil is the only real competitor, and though acetylene can never hope to compete with oil on the ground of cost, yet it may do so with some success on the grounds of convenience and health.

As regards actual progress in this country, the Manchester Acetylene Gas and Carbide Company is stated to have installed Kay's patent generator in over 100 county residences, in nine churches, in a few manufacturing establishments, and also to have supplied special portable apparatus for lighting portion of the Salford Docks of the Manchester Ship Canal. Messrs. Read, Holliday & Sons, of Leeds, have supplied their generator to a large number of factories and hotels, among which the following may be mentioned:—Wyke Valley Print Works, Bradford; Raven's Hall Hotel, Scarborough; Messrs. Wood Bros., Tockwith, York; Meal Bank Works, Kendal; and Toulston Lodge, Tadcaster.

The Thornton-Scarth apparatus is in use at Lord Pirbright's residence, Brookwood, Surrey, and at the Clifton Hotel, Liverpool. The remarks made above will explain why the writer considers the latter installation a mistake. Messrs. Thorn & Hoddle are supplying an installation of 80 25-C.P. lights to the village of St. Michael's, in Kent.*

In France the most noteworthy sign of progress is the decision of the General Omnibus Company, of Paris, to use acetylene for lighting the trams on the Louvre-St. Cloud section. The carbide is to be specially treated by the Serpollet process in order to obtain a coating of glucose upon it. On bringing into contact with water, a sucrate of lime is formed, which, being a soluble salt, facilitates the use of comparatively small generators. Details of the apparatus to be used will be found in the paper named below.†

At Bayonne, acetylene is being used for the lighting of several establishments, and owing to its proximity to several projected carbide factories, the innovation may be a permanent success.‡

In Germany a large-scale acetylene installation is reported at the town of Olivia, near Dantzig, where a 2,000 light generator on the Wolff system has been erected; cast-iron pipes are used for distributing the gas. The streets of Schonsee, West Prussia, are stated to be now lighted by acetylene. Lundstroem, in the article already referred to, states that there are already 6,000 !! installations for acetylene lighting in Germany. The writer is of opinion that two stray cyphers have been mixed up with this estimate, and that 60 would be nearer the correct total. The railway stations at Luchan, at Hildesheim, and at Altenstein, are now lighted by acetylene; while the communes of Bretrenheim, of Grunmen, and of Elberbech, have arranged for acetylene installations. The editor of the *Revue Industrielle* estimates the present consumption of carbide in Germany as between 5,000 and 10,000 tons per annum,§ while Liebetanz has more recently estimated the consumption in 1898 to be at the rate of 14,000 tons per annum.‖ The value he places on the carbide, namely, £500,000, is certainly excessive, and is equal to a price to the consumer of £35 14s. per ton. With carbide at this price, acetylene illumination will not prove economical.

Outside France and Germany the principal progress appears to be occurring in South-Eastern Europe, where coal-gas and electricity are hitherto comparatively unknown.

Thus, at Syra, in Greece, an installation of acetylene gas for public uses is being carried out, oil being the only competing illuminant. The carbide is to be imported from Belgium, and the acetylene is to be charged at the rate of 4dr. 50l. per 1,000 cubic feet. This is equivalent to 3s. 7d. per 1,000 cubic feet, and the estimate is evidently erroneous.¶

The use of acetylene, in conjunction with other gases, is considered by many to be the most promising field of exploitation, and mixtures of acetylene and oil-gas are being used upon some branches of the German State Railways. Wedding, of Berlin, has recently published details of experiments made with mixtures of acetylene and air, and with mixtures of acetylene and coal gas,* while Guilbert at the recent Buda-Pesth Congress read a paper on the use of mixtures of acetylene and oil-gas.† Mixtures of these two gases in the proportions 25 : 75 gave double the lighting value of oil-gas alone (not *treble* the intensity, as sometimes stated); but the most favourable results were obtained with mixtures containing 40 to 50 per cent. acetylene.

Taking carbide at £26 per ton in Paris, the cost of 1 cm. (35·3 c.-feet) acetylene gas will be 1s. 11½d., including 2·87d. for generating costs. The same volume of oil-gas costs 7·69d. Using these costs as the basis of calculation, the costs per c.-metre of various mixtures of acetylene and oil-gas work out as follows:—

75 % oil-gas 25 % acetylene	13·7d.	60 % oil-gas 40 % acetylene	12·38d.
50 % oil-gas 50 % acetylene	14·58d.		

The first mixture (25 per cent. acetylene) is that known as the Pintsch mixture, and is used under compression for railway carriage lighting on the German State Railway, as mentioned above.

IV.—Conclusion.

This review of recent progress in acetylene generation and utilisation shows that advancement is occurring, and that in certain directions the acetylene gas industry may undergo permanent and successful expansion.

This expansion is unlikely to occur, however, in districts where coal-gas and electricity are already established, or where they can be favourably installed as illuminants; and those who desire the establishment of the carbide and acetylene gas industries upon a sound basis, should recognise this limitation to their field of operations, and should, above all, discourage the circulation of false information concerning the relative costs of acetylene, coal-gas and oil, when used for illuminating purposes.

* Most of these installation notes are based upon paragraphs in recent issues of the *Journal of Acetylene Gas Lighting*.
† *Le Genie Civil*, July 1st, 1899.
‡ "Foreign Office Report," 2,250, May, 1899.
§ *Revue Industrielle*, June 24th, 1899.
‖ "Das Acetylen."
¶ "Foreign Office Report," 2,252, May, 1899.

* *Dingler's Polyt Journal*, May 13th, 1899.
† *Zeits. f. Angew. Chemie*, July 11th, 1899.

THE ELECTRIC DRIVING OF PRINTING MACHINERY.

We suppose there is hardly any class of motor work more "wrop in mystery" than the driving of printing machinery. Printing establishments rigorously bar their doors to the stranger, and electrical firms who have gained experience of such work, not unnaturally keep their information to themselves. Yet there is nothing very wonderful in being able to successfully drive a "Wharfedale," a rotary cylinder machine, or a two-century revolution press, and the character of the work ought not to vary very greatly from other machine work that is more or less intermittent in character. It is, however, the occasional nature of the printing press that renders it peculiarly adapted to an electric drive, and one would imagine that printers have only to become acquainted with the advantages of electric motors to become convinced of their fitness for the printing office. But the members of the great guild of the printing press are conservative, and doubtless this, combined with the apparent initial expense of electrical machinery, has been the cause of the comparative slowness to adopt newer methods. We are quite aware that many of the large printing establishments in the metropolis have been long converted to the claims of the electric motor, but when one reflects upon the enormous number of printing presses in London alone, it is apparent that the conversion has been a very partial one. Yet, of some of the printing offices we have seen equipped with electrical machinery, we are not filled with a consuming admiration.

While one ought not to be surprised at printers being disinclined to adopt electrical methods in old offices, there is little excuse for not adopting them when starting new works,

for it is under such conditions that electric driving proves itself to be immeasurably superior to all other methods. It not only means an economy in working the presses, but it actually affects the cost of buildings, for when shafting is dispensed with, a much lighter wall may be employed. In the methods adopted of applying motors to printing presses, the motors are very frequently applied direct to the shaft of a machine, in spite of the fact that it means a very large slow speed motor in many cases. If, say, the main driving shaft of a press makes five revolutions to every impression, a press operating at 1,440 impressions per hour would require a direct connected motor running at 120 revolutions per minute, which clearly means an unnecessarily large and expensive machine. Moreover, such a motor could hardly be of a standard character, and the replacement of any part would take a good deal longer than in the case of a standard type running at 600 or more revolutions per minute. This may be an extreme instance, but it shows that direct connection is not always desirable. Besides, the many improvements effected in gearing, almost render the direct-connected motor unnecessary; the raw hide pinion makes a gear noiseless, and although raw hide is dearer than gun-metal, it is, barring accidents, probably not less durable than a metal pinion. It is true that the low speed motor possesses the merit of a probable longer life, but few people care to spend money on a prospective advantage.

The introduction of the electric motor into the printing office has not entirely eliminated shafting, and though this may be regretted, it must be admitted that the individual motor is not always justified. For paper-cutting machines, for binders, and similar machines, the usual practice is to group them and drive them through the medium of a short length of shafting; such a proceeding rather neutralises the special claims of electric driving, but if a series of machines only require ⅛-H.P. each, it may be seen that it would be hardly an economical arrangement to employ separate motors. It would mean increased capital expenditure and increased maintenance charges. Perhaps the most objectionable method of driving a printing press is by a motor and a belt. True, it is simple and economical in first cost, but the arrangement is distinctly unsightly; moreover, the machine takes up more room. An electric motor ought to form an integral portion of the machine it drives.

The experience of some printers, after using electric driving, is interesting and worthy of being put on record. Not long ago a contemporary devoted to printing interests referred to the introduction of electrical driving in a well-known printing establishment in London and said, "A very powerful argument in favour of the new method of driving is afforded by noting that the same gas engine, which only sufficed for driving half the machinery at the older premises, now does all the work of driving at the new works, and in addition to this, gives force for some 260 lights." Such a statement ought not to be without its effect, and even the figures put forward occasionally by electrical contractors are worth remembering. Two typical instances may be mentioned. A well-known printing house, before it adopted electric driving, spent £9 per day for fuel alone: after adopting a much larger plant (electrical) and with added cost of light, heat, and elevator service, the cost averaged 35s., a saving of £7 5s. per day. The American Lithographic Company reported that electricity for driving purposes saved 44 per cent. over previous methods. There is more reticence in this country, for reasons which we have already advanced, but, in spite of that, it is possible to give some information as to the power usually required by various printing machines. Mr. Alfred Gibbings some time ago made a series of tests on the power required by different machines, and obtained the following approximate figures:—

Letterpress, Wharfedale, Bremner and Cylinder Machines.

Demy, to print a sheet	24 × 18 inches	...	...	1 H.P.
Double crown	30 × 20 "	...	...	1 "
Double demy	36 × 24 "	...	...	1½ "
Quad crown	42 × 30 "	...	...	1½ "

Golding Jobber, Minerva, Arab, Universal, &c., Platen Machines.

Foolscap folio, 7 × 11 inches inside chase	...	...	½ to 1 H.P.
Crown folio, 10 × 15½ " "	...	...	½ to 1 "
Demy folio, 13 × 9 " "	...	...	½ to 1 "
Linotype machines	...	...	½ H.P.

Lithographic, Bremner, &c., Machines.

Demy, to print a sheet	24 × 18 inches	...	...	1 H.P.
Double demy	36 × 24 "	...	...	2 "
Quad royal	50 × 40 "	...	...	4 "

Guillotine Cutting Machines.

26 to 32 inches wide	...	...	...	¾ H.P.
38 to 44 "	...	...	...	1 "

Paper Glazing Machines.

To roll 27 inches wide	...	...	...	3 H.P.
" 33 "	...	...	...	4 "
" 36 "	...	...	...	5 "

Ink Grinding Mills.

Rolls 12 × 8 inches	...	...	...	3 H.P.
" 18 × 10 "	...	...	...	4 "
" 24 × 12 "	...	...	...	5 "

From careful investigations that were made at the publishing offices of *McLure's Magazine* (New York) it was found that automatic cylinder presses required a motor of about 4 or 5 H.P., and with that could turn out impressions up to 1,200 per hour, according to the nature of the work to be done; rotary presses capable of turning out 2,000 sheets per hour required 15 H.P. motors. Some other interesting tests have been made in America, and were published some time ago by a writer whose name we have forgotten, taking a series of printing presses and the power required for certain sizes of sheets:—

Size of sheets.	Sheets per minute.	Character of forme.	H.P.
42 × 60	21	Light	2·36
42 × 60	22	Medium	2·78
16 × 22	22	Light	2·40
31 × 40	26	Heavy	2·50

The variation in these figures rather suggests different types of printing machine. It is curious how the production of different machines varies with the manner in which the motors are connected, though no definite conclusions ought to be drawn from them.

Type of machine.	Size of motor.	Average sheets per H.P.-hour.
Michle No. 0000 ...	5-H.P. geared	500
" No. 00 ...	2 or 3-H.P. geared	663
" No. 00 ...	3-H.P. direct connected	720
" No. 000 ...	4-H.P. direct connected	640
Hoe No. 8	7·5-H.P. geared	360
" No. 7	3-H.P. geared	527
" No. 7	4-H.P. direct connected	395
Cottrell	7·5-H.P. geared	570

As was pointed out by the author of these tests, the number of printed sheets per H.P.-hour by any combination of press and motor will depend largely upon the forme, the size of the sheets printed, and the viscosity of the ink, so that it would be always difficult to obtain definite data unless one knew these.

ELECTRICITY v. STEAM FOR BRANCH RAILROAD LINES.

The summer conventions of the Institution of Civil Engineers should be exceedingly valuable, inasmuch as the topics presented for discussion are short, and the informal discussion can be carried on at length. The ready interchange of experience and ideas between members ought to result in an all-round acquisition of useful and practical knowledge which one can hardly expect to imbibe at the formal Tuesday evening meetings held during the winter session.

Some specially interesting topics were presented this summer on traction by means of gas, steam and electricity, but, as we remarked at the time, the discussion gave rise to a feeling of disappointment. We are not quite sure in our own minds whether the chairmen of the various sections are always in the best position to know the best men in any given branch of engineering, especially of electrical engineering, to call upon to take part in the debate, but, be this as it may,

the information then given to members on electric traction was meagre and indefinite to a painful degree.

A subject of considerable magnitude, and of first-rate importance to this country, is that indicated by the title under which we pen our comments, for we know of several districts where influential residents are anxiously awaiting the advent of electric traction, in some shape or form, to open up communication between important centres of industry, and between inland towns and rapidly rising seaside resorts.

By a lucky coincidence, we have at our disposal some valuable opinions on the subject from engineers who, in their own land, are classed as a similar body to our own Institution of Civil Engineers; and just three months ago, at the Annual Convention of the American Society of Civil Engineers, an informal discussion took place on "What are the Economic Conditions under which Electricity may be profitably Substituted for Steam in the Operation of Branch Railroad Lines, and what are the Engineering Requirements to be Considered in such Substitution." Over a dozen gentlemen, members of the Society, took part in an animated debate which, in a concise and abbreviated form, we have culled from the *Proceedings of the American Society of Civil Engineers*, and give below. It will be noticed that traction by means of accumulators mounted on locomotives is not touched upon, although in a place where water-power is available, this system ought, with the improved batteries now obtainable, to turn out commercially successful for light traffic with frequent trips. If such well-known and experienced electric traction advocates as Mr. Crompton, Mr. Dawson, Mr. Parshall, Mr. Sellon, Mr. Quin, Mr. Rider, Mr. Charles Hopkinson, Mr. Manville, Mr. Clifton Robinson, Mr. Dickinson, Mr. Garcke, Dr. E. Hopkinson, Mr. Raworth, Mr. Clirehugh, Mr. Baldwin, Prof. Carus-Wilson, Mr. A. Siemens, Mr. Thomas Parker, and others, would warmly take up the matter here and continue the discussion, a mutual benefit would be conferred upon both English and American engineers, and we should be only too pleased to make the ELECTRICAL REVIEW the medium for such an interchange of opinion.

The topic to which we have alluded was brought forward by—

Mr. H. S. HAINES, who said as he was responsible for the submission of this subject for discussion, he would undertake to state the purpose he had in view in suggesting it. Electricity has been gradually introduced as a motive power on railroads, first as a substitute for horse-car lines in cities, then into continually widening areas, with the extension of such lines into suburban districts; all the time offering more formidable competition to steam railroads, until it has become a question as to its substitution for steam on some of these very lines. The profitable substitution of electricity for steam in a railroad motor probably varies with its application, whether to the traffic on a strictly suburban branch, or to a branch in a rural or manufacturing district. There is also to be considered the advisability of its application alternately with steam on the same line. The conclusion seems to have been reached that this substitution can be more profitably made where it is desired to move single cars frequently, rather than where it is required to move heavy trains at infrequent intervals. In planning quite a long main line, Mr. Haines had occasion to provide for several branch lines to reach factory sites or manufacturing villages, at varying distances from the main line, where a mixed train, making one or two round trips per day, might meet all the requirements, at least for a year or two after the branch lines were opened. In one case it would be practicable to obtain current from a factory where it was generated by water-power. In this way his mind was directed to the subject, but he was not sufficiently familiar with the economic conditions affecting the transmission of an electric current, and its use as a motive power, to determine the question satisfactorily to himself, and hence its reference to the Society for discussion. It is distinctly as an engineering problem that Mr. Haines asks for a solution. There is an apparent disinclination on the part of civil engineers to consider, as appertaining to their domain, the application of electricity in connection with engineering works, in the same way that they accept and discuss questions involving the use of water or steam-power. As a help to himself, and to others similarly interested, he would like to have a discussion of the conditions under which it would be advisable to operate by electricity a branch line to a steam railroad, whether in a suburban, a manufacturing, or a rural district; the conditions including the length of the branch, the character and frequency of the traffic, the generation of the electric current by water-power or by steam, &c. The subject should be considered, not only with reference to lines with a large traffic, but also as applied to branch lines operated only by one locomotive with a single train crew, making one or two round trips daily. If these conditions can be determined with approximate accuracy, the field for the application of electricity will be accordingly extended, and perhaps it will thereby become more feasible to provide traffic facilities for communities, to which they cannot be profitably extended with steam as a motive power.

Mr. HENRY G. PROUT said the question is pre-eminently one of traffic conditions rather than of strictly engineering conditions; although engineering covers traffic conditions. Under such requirements as Mr. Haines has suggested, *i.e.*, branch lines with infrequent trains, it would not be advisable to try to substitute electricity for steam locomotives; and it is quite likely that during the next few years light steam motors for such work will be developed. The costly installation of the New York, New Haven and Hartford Railroad at Hartford and Berlin, Conn., will probably be found to be a very expensive and unremunerative experiment. It is said that about half of the machinery in the power house is lying idle, and that one-car trains are run at intervals of 20 or 25 minutes. Under such conditions it is impossible to pay the interest on the cost of the installation. In other words, if the traffic is in units of considerable size at infrequent intervals, the work can be done more cheaply by steam locomotives than by electricity. A locomotive which will develop, say, 1,000 H.P., will cost (we will assume) $10,000, and a power house and plant to develop 1,000 H.P. will cost, perhaps, $80,000. Thus it will be seen that the interest on $70,000 has to be earned, or accounted for in some way by the superior economies of the electric installation. It may be said that there will be a great saving in the fuel account, but careful analysis, made within the last three years, has shown that the fuel will cost as much per horse-power delivered at the rim of the driving wheel for electricity as for a steam locomotive. Although in a fixed plant cheaper fuel can be used, and with all the appliances of automatic stoking, &c., can be burned more cheaply than in the steam locomotive, yet the losses in efficiency of the generator, in transmission, and in the motor, are sufficient to overcome that saving, and by the time the power is delivered at the rail it will have cost as much in coal as by the locomotive. This seems to be a safe general proposition, although Mr. Baker, general superintendent of the Manhattan Elevated Railroad, has lately said that many improvements have been made within the last year or two, and greater efficiency is obtained from the generators and motors. But even if a saving in coal of, say, 50 per cent. can be made, yet, after all, the fuel item in the operation of a railroad is comparatively small. Assuming the fuel element to be about 13 per cent. of the total operating expenses, then, even if the saving in this item is 50 per cent., it is evident that little has been saved toward paying the interest on the expensive electric installation. If the traffic is such that its efficiency, or commercial development, requires a minute sub-division of the units, that is, a division into very small units running very frequently, in order to induce traffic to move, then, of course, electricity will win, not because it is cheaper than steam, but because it is adapted to such minute sub-division.

Mr. OBERLIN SMITH said that within the last 10 years the ordinary street trolley line has grown from a mere experiment into a great industry. The time for the universal use of motors on railroads has not yet arrived, but he believed that it would come eventually, in consequence of discoveries which will cheapen the use of fuel and simplify electrical machinery; and also because such a method will result in greater convenience to travellers, by reason of more smoothness of motion, freedom from dust, smoke, cinders, &c., and facility for running single cars (or short trains) at much more frequent intervals than now. It therefore follows that the use of electricity on roads which are at present run by steam will largely increase travel—and the habit of travelling. Such improvements make car riding a pleasure rather than the duty that it now often is. The foregoing remarks apply to travel on surface roads, at speeds much the same as now practised. The change in method has already begun, and its adoption by all railroads is simply a matter of relative cost—in construction, maintenance, and operation. It would seem probable, however, that in the next generation, if not in this, an entirely new type of high-speed railroad will be developed. Mechanically the world is ready to begin it; financially, not yet, for its cost would be great. Upon some special type of track, confining the cars absolutely against derailment, a speed of 120 to 150 miles per hour, and possibly more can doubtless be obtained; and it would not seem to be a very wonderful feat to cover the 90 miles between New York and Philadelphia in half or three-quarters of an hour. There are no physical or mechanical obstacles which cannot be overcome with our present knowledge and some experimenting with details. The danger of collision with other objects can be avoided by the use of an elevated roadway with absolutely no crossing, turn-tables, or switches, and with the trains run upon a positive electric block system, in one direction, on one track. The question of derailment and collision being obliterated, the speed of trains will be limited only by air resistance and by the strength of the wheels to resist centrifugal force—if wheels are used. If the cars are made long, narrow, pointed, very smooth and properly jointed together when in trains of more than one, they can probably be run at high speed without encountering such great air resistance as would make the cost of power too great. Such cost, however, must not be based upon present train weights in relation to live load. It has been demonstrated that a heavy steam locomotive and train can travel upwards of 100 miles an hour, with all the disadvantages of a tremendous load not on the drivers, and a degree of uncertainty as to whether or not the train will stay on the rails. If, however, such a train could be made safe upon a surface road, at the speeds under consideration, and did it not cost too much for power, yet there are limitations of speed in respect to getting steam through the ports quickly enough, and in working reciprocating members—as pistons, connecting rods, &c. These limitations do not exist with rotating electric motors. One reason why electricity works better upon steep grades is that, with the best modern systems, every wheel in the train can be made a driving wheel. A train can be comparatively light, without the dead weight of a locomotive, and yet have sufficient traction. With a steam train we not only have the cars very heavy, especially Pullman

cars, but we have the big locomotive itself to drag up grades, with only the adhesion due to the weight of part of the locomotive, such as happens to be on the drivers. This is evidently very different from being able to have a very light train and making every wheel a driver, with every pound of the train and load contributing its share of adhesion.

Mr. W. B. Reed said the discussion, up to this point, has referred mainly to passengers. The question of carrying freight in combination with passengers, upon electric lines, should also be discussed. Generally speaking, it has been found that for short distances passengers can be carried more comfortably and more cheaply by electricity than by steam, but in the carrying of freight little has been done by electricity as yet. When freight is to be carried over passenger lines by electricity it will have to be taken through city streets, or at least over highways, and the rails should be designed to meet the conditions of electric cars which have shallow flanges; freight cars with deeper flanges, and which vary more or less in gauge, requiring not only a deep groove but a wide flangeway; and the ordinary vehicle traffic.

Mr. G. S. Davison said about eight or nine years ago he was in charge of the construction of a small branch line near Pittsburg, which was required to connect a small manufacturing town with the Pittsburg and Lake Erie Railroad and the Pennsylvania lines. It was an independent corporation, controlled by manufacturers in the town, and it was equipped at first with steam-power. The president of the company conceived the idea that with such cheap fuel as is to be had in that neighbourhood, and in view of a proposed change in the future from steam to water-power, it would be proper to operate this branch by electricity instead of steam. He experimented slowly, and equipped the line as a trolley road, but separated the passenger and freight traffic, and carried the former by electricity, and the latter by steam locomotives. He did not know the results of the operations of this company, but judging from later occurrences, he believed that the separation of the passenger and freight service was found to be a mistake. In this case the company had ideal conditions for cheap fuel, and had also its own electric power plant. It was not necessary to instal a new plant, but simply to add to the old. The road was afterwards purchased by the Pittsburg and Lake Erie Railroad Company, and is now being operated as a branch of that road. The company, on acquiring this branch line, studied its operation to determine whether it should be conducted as an electric line in part or as a whole, or whether it should be operated as a steam road. As the electrical equipment was discarded and as the road is now being operated by steam, it may be assumed that electricity was found to be uneconomical. The causes which led to this change are not known to the speaker, but he suggests that possibly the trolley equipment might have been found very inconvenient when operating the road by steam as a freight line. The third-rail system may prove to be more practicable than the trolley in such cases, but the latter must be excluded on account of its inconvenience. In the vicinity of Pittsburg there is a large mine which is operated for some seven miles back from the point where the coal is brought to the tipple; the means of bringing the coal to the opening being virtually a small branch railroad. This branch passes through several tunnels and has been operated as a steam railroad for a number of years. At the present time the first five miles of the road is being operated as an electric line, using the trolley system, and on the remainder of the line, next to where the coal is brought out to the tipple, steam locomotives are used. The owners stated that the operation had been planned in that way, and that they had been justified in hauling the coal the first distance by electricity, because the use of steam locomotives in the mines was detrimental to the health of the men. But, taking full account of the cost of installation, power, &c., they had not found that it would be cheaper or better to continue the use of the trolley to the tipple. The fuel of this power station is delivered directly from the mine into the boiler house, and yet, on the five miles operated by electricity, the saving on fuel is so small that the expense of an electric equipment for the remaining two miles would not be justified.

Mr. Walter L. Webb said the relation of grades to the question of steam or electric operation has not yet been touched upon in this discussion. On a steam railroad, a grade of 2 per cent. is considered steep, while 4 per cent. marks almost the limit of working on such roads; yet on many of the electric railroads in the United States there are grades of 10 per cent., and even steeper. On steam roads which are steep in some places and flat in others there is a great waste of power. This occurs, not on the heavy grades where the engines are hard worked, but on the light grades, where the great reserve power—at those points doing practically no work—has to be maintained for service on the heavy grades. On an electric road, the amount of power used is almost proportional to the work to be done, and this is an important element in its economy. Assuming a fair amount of traffic, so distributed as to keep the road in uniform operation, electricity will, in many cases, prove more desirable than steam locomotives, taking into consideration the interest on the cost of the construction and installation, and the expense of operation, and this will be true for these reasons alone, to say nothing of the possible economies consequent on a utilisation of water-power.

Mr. J. James R. Croes said the economical generation of power, either steam or electric, implies a constant and continuous operation of the generating plant. When variable power is needed, the generating plant must be constantly operated at its maximum efficiency. When the work to be accomplished can be distributed over a continuous period of 10 to 24 hours, the power can be more economically generated by an indirect application through a stationary plant than by a direct application of the fuel to the motor, as in the steam locomotive. Where, however, the work involves a spasmodic application, occupying only a limited amount of time, at irregular periods during the day, the generation of power by an independent motor, capable of producing in itself the power needed, is more convenient and more economical than its production by a central plant. Steam-power at the present day can be generated spasmodically more efficiently than electric power. The requirements of railroad service on a line of limited traffic are spasmodic, reaching a maximum at certain hours; and until a storage battery has been devised in which the power produced continuously can be stored and used for spasmodic application, which application shall satisfy a maximum call greater than the average efficiency required of the generating plant, electricity cannot be applied more economically than steam. At present, it seemed to him that where the work is spasmodic, steam power is, and must be, more economical than electric power, for branch railroads.

Prof. D. C. Jackson said there is no mystery about this matter, and Mr. Croes has well stated the case. It is more economical—not more efficient—to generate power for operating a railroad or a group of manufacturing establishments at a central station only when the power can be used continuously over long hours, for the reason that when the traffic on the railroad or the load on the motors at the manufacturing establishment is continuous, the demand on the central station for power is continuous, and the cost for interest and labour per horse-power-hour developed by the station is brought to a reasonable figure. Where traffic requirements are intermittent, it is more economical to operate a railroad by steam locomotives. If a plant of 1,000 H P., installed to operate a branch railroad with freight traffic, is called on for its output for only three hours of the day, 24 hours of interest charges lie against the three hours of output. There are at the station daily possibly 10 hours of full labour and 14 hours of one-half or one-third labour, and if this is charged against the three-hour output, it makes the cost of operating the station, per horse-power-hour, enormous. Whether or not electric power may be economical in various cases is, as Mr. Prout has said, a matter of the distribution of traffic. These remarks apply equally to electric power plants where the prime power is derived from steam engines or water wheels. The larger cost of development of a water-power plant will often cause an excess interest charge which is equal to the cost of fuel in a steam plant designed to do the same work, and the average small water-power plant does not embrace such economical advantages as are generally ascribed to it. The case of a main line feeder, as put by Mr. Haines, is a special case under the general proposition, and under some circumstances it is possible that electric power can handle the traffic most economically. These conditions would assume a number of main line feeders, located reasonably near a given point, so that the entire load of all these branches may be carried by a central station, using a fairly high transmitting pressure. The traffic should be broken into units somewhat smaller than would be operated ordinarily by steam power direct, and schedules of train movements should be so arranged that the station may be fairly well loaded during at least 12 hours. If the schedules are so arranged that once or twice during the day a single mixed train will be running simultaneously over each of these branches, he doubted if electric power, from the point of view of dollars and cents, can ever compete with the steam locomotive.

Mr. Gustav Lindenthal said a railroad train, in descending a grade, wastes power in grinding up brake-shoes, and heretofore this power has not been stored in any form. It is possible to generate and store that power in the form of electricity, which can be used again in hauling trains or cars up an ascending grade, or for lighting or heating purposes. He believed that the feature of storing electric power should have an important bearing in any comparison of the economies of locomotive and electric traction, particularly in mountainous countries, where coal may be dear and water-power cheap.

Mr. Edward Wegmann said he objected to the statement that steeper grades can be used on electric tramways than on ordinary steam railroads. While it is undoubtedly true that steeper grades are used on trolley lines than on ordinary railroads, this difference should not be credited to electricity as against steam, but to the placing of a motor under each car. If a steam engine were applied to a car in this manner, the car could be driven up any of the grades to be found on trolley lines. Before any trolley lines had been constructed he had spent two or three years in assisting an inventor in developing and introducing a steam street car, which was run successfully in Brooklyn. This car, which was propelled by a small three-cylinder steam engine, placed between the axles and suspended from the car frame, was able to run up 10 per cent. grades. While such a car might be used to advantage, where only a few trips had to be made each day, it had several disadvantages compared with trolley cars: 1. The weight of the boiler was objectionable. 2. A licensed engineer was required for each car. One of the great advantages of the trolley system is that men of ordinary intelligence can soon be taught to run the cars. In the case of pulling a train by a special motor, the grade that could be overcome depended, as was well known, on the weight on the driving wheels, the rolling friction of the wheels, and the weight of the train. It made, therefore, no difference as regards the grades, whether steam, electricity, compressed air, or any other motive power were used to propel the motor.

Mr. Robert Moore said each particular case of this kind must be considered by itself. In the case indicated by Mr. Haines, in which the power is to be rented and paid for, presumably, by a meter, the conditions of economy would be very different from those in which the railroad company would be required to instal the plant, and bear the cost of the current whether it were being used or not. Therefore a proposition which would cover all cases might be very delusive. So far as a general proposition can now me made, it must be substantially as indicated by Mr. Prout. When the conditions are those of an urban traffic—a very large number of small trains—electricity has abundantly demonstrated its superiority over every other form of motive power; but when the conditions are very different from those of urban traffic—when the trains are infrequent or heavy—he doubted its economy, and saw no indications that it is

likely to be economical in the near future. Regarding the superior economy claimed for the electric motor on heavy grades, the point cited by Mr. Wegmann is a sufficient answer. The power is developed only by the traction of the driver on the rail, and that is a function of its weight; thus, there can be no saving in that respect. But there is another point which should not be lightly regarded, the great danger, in operating on very steep grades, of the failure of brake power. Any such failure means disaster, as many who have had occasion to operate heavy grades well know.

Mr. C. W. Buchholz said the facts are against the assertion that the grades on an electric road can be steeper than on a steam road. The power of a locomotive depends upon its adhesion to the rail, and it makes no difference whether the power is steam or electricity.

Mr. Haines, in reply, said: This question was suggested because he considered it to be of practical moment, and because he desired to obtain from members of the Society an authentic expression of opinion as to how far, in the present state of the art, it was advisable to substitute electricity for steam as a motive power on branch lines of steam railroads. If electricity is used on branch lines it must be used in connection with the vehicles in which passengers and freight are transported on the main lines. It is not only desirable to ascertain what can be done with electricity under this aspect of the case, but also what cannot be done. There is one general proposition that all will accept, viz, that in the present state of the art there is no doubt that electricity can be economically substituted for steam on a branch of a steam railroad where there are single units of transportation moving at frequent intervals, because the power can be used uniformly and continuously, and because a large plant is not lying idle for the greater part of the time. To state the cases in which electric transmission cannot be applied, a process of exclusion must be used; therefore, let it be said that it can be applied economically on branch lines for suburban purposes. If that is the case, it strengthens the steam railroads which have suburban branches competing with trolley lines. He recently had occasion to talk this matter over with some of the principal officials of the New York, New Haven, and Hartford Railroad, who have probably had more experience in this matter than anyone else; and the impression received was that they are quite well satisfied with what they have done thus far in an experimental way, and they are extending the system. There is one point, however, that they have not yet determined, and that is, the conditions under which the third rail should take the place of the trolley wire. Admitting that electricity can be used economically on suburban lines, the next question is: Can it be used on branch lines under other conditions? Judging from the discussion, Mr. Haines believed that electric motors might be used to great advantage on branch lines in a manufacturing district, even for handling freight, if power can be obtained along those lines from manufacturers who have it to spare. On a line running into a rural district it would seem hardly practicable to use electricity, unless water-power could be obtained. He need not discuss the question of heavy grades, as that has been covered so well by Mr. Buchholz. Unless by the use of electricity the traction can be made stronger than the mere adhesion due to the weight of the locomotive, that question need not be considered. To sum up, it may be said that in the present state of the art it is only admissible to apply electricity on what may be called suburban passenger lines, except that it may be applied where power, for certain local reasons, may be obtained more cheaply than by means of the steam locomotive.

AMERICAN LOCOMOTIVES IN GREAT BRITAIN.

A very curious article appears in *Cassier's Magazine* on the above question, from the pen of Mr. C. H. Jones, of the Midland Railway. Mr. Jones as a railway man, belongs to that body of men whose efforts in the way of bringing about the building of engines by the railway companies themselves, are the cause of the fact that the locomotive shops of the country are so small. Mr. Jones's article is very curious reading, and is an example of special pleading of an apologetic order, as though he felt somewhat afraid of the whole business, and had to justify it somehow. He begins by blaming the English makers who, too small to furnish the engines wanted by Mr. Jones's friends, could not promise prompt delivery, and could hardly enlarge their shops quickly enough to do so. Moreover, the Midland, or any other company, would not have gone outside their own railway works had they not been very hard pressed, so it is hardly fair to put a slur on the English builders. Mr. Jones is full of the virtues of Americans. They are satisfied with less showy engines than we in England, he calmly states. Why, in the world, if this be a virtue, have the Midland Railway only just found it out? Any locomotive builder in England would be glad to furnish the same rough and unfinished stuff. As an example of American finish, we might cite the coupling rods of American engines and other similar parts, which are bright only on the face side and left as forged on the other side.

This, we admit, is perfectly good practice, but why have Midland directors and their men in the locomotive department only just found it out? The Midland Company's own shops would appear to be very badly carried on, for Mr. Jones is struck with wonder that American engines are made to template and are accurate. He actually puts down this as an argument in favour of American engines. Is it because Mr. Jones has influence, that the same system is not carried out on the Midland, for evidently by Mr. Jones's surprised statement, it has come to him as a novelty? He ought to get some experience at Crewe or Horwich. And so Mr. Jones jogs along stating what ought to be mere platitudes if the Midland Company has been properly served by its locomotive staff. He tells us how many packing cases were needed to pack each Baldwin engine, and is good enough to startle us by a statement that they are not all of the same size or even of the same weight. Very foolishly, too, the engines came by the Manchester Ship Canal, a work that, we believe, railway men were loud in declaring would never be built, and when built would never be used. From Mr. Jones's description of some of the details, it appears that the makers have been allowed to put in the cheapest kind of material, and have narrowed the fire boxes by the bar framing just as is usual in American practice. It is very evident that had English builders been allowed the same latitude in departure from the Midland style of engine and the same cheap construction and finish, they could have promised much quicker delivery. Mr. Jones's article, coming as it does from a Midland official, only shows how ridiculous have been the officials of our railways when they accept as good enough a class of work so far inferior to what they have demanded from home makers. We do not necessarily condemn the style of finish they have agreed to accept, but we cannot praise their consistency in purchasing engines practically without inspection or specification after their past demands. They have accepted locomotives with three supporting points to the boiler, with valve boxes out in the cold, single wheel bogies, outside cylinders and no foot plates —merely running boards. It is all cheap work and design, and if it is going to pay the Midland Company, is it not a pity they did not find it all out years ago and reduce some of their heavy charges that have driven manufacturing out of their district to the seaside?

TRAIN LIGHTING.

A writer on the staff of the *Railway Engineer* is much exercised over two of his contemporaries.

Recently, says our iron road exchange,

The *Engineer* stated that it was informed that the total weight of the electric plant (Gill system) was less than that of a gas lighting system giving an equal amount of light. Pintsch's Lighting Company replied that the fittings necessary for a better light by their system weigh rather less than half the weight of the fittings necessary for the electric system. The *Engineer* suggests that the correct weights of both systems should be published, and the Electrical Review thinks that, "this information, if forthcoming, should be interesting."

It is surprising that the *Engineer* should have allowed such a vapid, misleading, unfair, but technically accurate statement to have appeared in its columns.

In the electric system all (except spare accumulators) the plant is carried on the coach, and therefore no doubt its *total* weight is less than that of the plant necessary to produce an equal amount of light by the Pintsch system would be; but in the Pintsch system none of the generating plant is carried about on the coach, and the gas holders and fittings which are carried only weigh, as stated by the Pintsch Company, about half as much as the total electric plant. This extra weight is a very important factor for locomotive superintendents to consider, and they are not likely to attend to stupid remarks about "the *total* weight of the plant" when they know perfectly well that with the electric system the locomotive has got to do the work of lighting the train, and with the Pintsch or Pope gas systems it has not. The weight of the plant carried cannot be usefully, or (with due deference to our electrical contemporary) interestingly *considered apart* from *the much more important question of the* extra work *thrown upon the locomotive in order to generate the necessary electric currents.*

Without discussing the shocking impropriety of taxing the *Engineer* with stupid remarks as to the respective weights of the gas or electric equipments, we will consider how far the railway organ is justified in gravely trying to make its readers believe that the extra work of the locomotive in driving a small dynamo is of such vast importance that the officials, whose duty it is to superintend the locomotive departments of our great English lines, are to have their unhappy lives burdened by another heavy responsibility, heavier by far than the weights of gas cylinders, or dynamos and batteries.

We may remark that what our contemporary calls the Gill system is better known as Stone's electric light system, Mr. Gill being the manager of Messrs. J. Stone & Co.'s electrical department.

The relative weights of gas and electric light apparatus must depend not only on a variety of circumstances such as the size of coach, amount of storage capacity required, &c., but any correct comparison is rendered quite impossible by

the fact that whereas gas-lighted coaches require to be recharged at more or less frequent intervals (either from the gas works or from travelling gas holders), coaches fitted with Stone's patent system are not dependent on any storage, but can run, so far as the lighting is concerned, at any time, for any distance, and over any railway, the lighting being perfectly automatic and independent of charging facilities, &c.

We are informed that largely from this cause electrically lighted coaches run a very much greater mileage than cosches requiring to have their reservoirs periodically charged with gas.

Altogether apart, however, from these considerations, the question of any difference which may exist in the relative weights can be of no practical importance, as it cannot amount to more than an insignificant fraction of the total weight of the train.

This remark applies equally to the question of extra power required for haulage. Some time ago a test was made by Prof. Capper, of King's College, with a view to ascertaining what was the actual power required for driving these dynamos, and the result shows that this could not amount to more than 0·6 H.P. per coach, being equal to an extra consumption of fuel of $\frac{1}{10}$th lb. per coach per mile at both high and low speeds.

It is interesting, however, to note that the actual practical experience of the locomotive superintendents of the various railways where Stone's system has been fitted to large numbers of coaches for upwards of 12 months, demonstrates that there is no appreciable increase in the consumption of fuel. Considering what a very small fraction of the total power of the locomotive is required, no different conclusion could have been expected.

Even the systems which may now be termed more or less obsolete could scarcely have exercised the minds of locomotive superintendents to the extent that our contemporary would have us believe Stone's method will involve. We have in our mind's eye a typical example of a London, Brighton and South Coast train which is made up of Pullman cars, bogies, and ordinary carriages. It is composite in its illumination, being lighted partly by gas, partly by electricity in the proportion of five coaches with the former to 21 with the latter. The total number of electric 8-C.P. lamps is 140, the weight of the train complete is 360 tons, the average speed 46 miles per hour, and the average horse-power developed by the locomotive is 550. The calculated horse-power we find agrees very closely with the observed horse-power. Yet the weight of two dynamos and the secondary battery is less than 2 per cent. of the whole train, and the "extra work thrown upon the locomotive in order to generate the necessary electric currents" is less than 3 per cent.! And these, forsooth, are the very important factors for locomotive superintendents to consider!

The London, Brighton and South Coast Railway Company was one of the pioneers of train lighting by electricity, under the able supervision of Mr. E. Houghton; and it may interest, even if it grieves, the *Railway Engineer* to learn that the company is about to discontinue its own system of lighting and adopt that of Messrs. Stone, the very system which has aroused our contemporary's ire. The reason assigned for this change is the inability of the company's method to light independent coaches, the plant being concentrated in the guard's van, which is inconvenient.

The coaches of this company are light compared with the 20-ton carriages, say, of the Great Western, and with the adoption of Stone's system, we shall certainly be surprised if, generally speaking, the weight of the electric lighting plant is much more than 1 per cent. of that of any train, or if the power required for driving the dynamos ever goes beyond 2 per cent. of the horse-power developed by the locomotive. In any case, as Mr. Houghton tersely puts it, "So far as I can learn, the weight of the electrical apparatus and the power required for working it are of little importance in such a train." The following tables of the approximate annual cost of Messrs. J. Stone & Co.'s electric light system, as compared with gas and oil lighting, should appeal to those railway companies who still pin their faith to dangerous gas lighting or miserable oil illumination! If the directors are blind to the advantages of electric lighting, the shareholders should combine to remove the scales from their eyes, for to them economy effected in expenses of working means increased dividends.

Gas.

Table A.—Average cost of production of oil gas, exclusive of maintenance, &c. (See Table B.):—

One-tenth of a penny per hour for 8 C.P. One-fifth of a penny per hour for 16 C.P.

	Per coach per annum.
If lights burning 4 hours per day, 8 C.P. per compartment	£3 13 0
" 4 " 16 " "	7 6 0
" 7* " 8 " "	6 7 9
" 7* " 16 " "	12 15 6

Table B.—The experience of some of the largest users of oil gas among the English railways, shows the cost of gas, including maintenance of gas producing plant, filling gas cylinders and holders, repairs to gas fittings in carriages, &c., to average about 13s. per 1,000 cubic feet. The consumption of gas for 8 C.P. light is 1 foot per hour, and for a 16 C.P. light, 2 feet per hour.

	Per coach per annum.
If lights burning 4 hours per day, 8 C.P. per compartment	£5 14 0
" 4 " 16 " "	11 8 0
" 7* " 8 " "	9 19 6
" 7* " 16 " "	19 19 0

Oil Lighting.

Table C.—Average cost of oil lighting, including expenses incidental thereto, is between ⅝d. and ¼d. per lamp per hour. Taking the lower of these figures, ⅝d. per lamp per hour, this would give the following:—

	Per coach per annum.
If lights burning 4 hours per day, 5 C.P. per compartment	£13 14 0
" 7* " 5 " "	24 0 0

* In case of tunnels.

Table D.—The cost of producing the electric light by Stone's system is simply that of the fuel consumed by locomotive for extra haulage, which, according to calculation, should be as follows, though, as a matter of fact, the experience of the locomotive superintendents of railways who have used Stone's system for upwards of 12 months is that the extra consumption of fuel is imperceptible:—

Lights burning.	Extra fuel burned per coach per annum.	Price of fuel per ton.	Per coach per annum.
4 hours per day, 16 C.P. per compartment.	20 cwts.	15s.*	15s.
7 hours per day, 16 C.P. per compartment.	35 "	15s.*	26s. 3d.

* On many railways the price of fuel would, of course, be much less than this

Table E.—The cost of maintenance of Stone's electric light system, including renewal of lamps, plates of accumulators, belts, bearings, and other wearing parts (spread over, say, 300 coaches), is estimated to be as follows:—

	Per coach per annum.
If lights burning 4 hours per day, 16 C.P. per compartment	£2 0 0
" 7 " " "	3 10 0

Summary.

As compared with oil gas the annual cost of Stone's electric light system is less than half, while giving double the light, or less than one-fourth for the same amount of light, whilst at the same time saving all the trouble and derangement of traffic necessitated by having to charge the reservoirs in carriages with gas.

As compared with oil, the cost of Stone's electric light system is about ⅓th, whilst giving more than three times the light.

Messrs. Stone & Co. set themselves to fulfil the three following conditions, which were essential to train lighting, and their perseverance seems to have met with a most gratifying reward. The conditions laid down were as follows:—

1. Each coach must carry its own generating plant, and the installation must be complete in itself, so that every coach should be independent of every other coach.
2. The amount of electric current produced must be practically the same whatever the speed of the train might be.
3. That each coach must be fitted with an accumulator, which should automatically come into action whenever the train was brought to a standstill without interfering with the steadiness of the light, and have sufficient storage for all stoppages at stations or elsewhere.

The system, details of which are well known to readers of the Electrical Review, has already been fitted, or is in course of being fitted, on upwards of 100 different lines of railways, and, as frequent travellers on the Great Western, we should be glad to announce in the near future that the directors of this very conservative company had availed themselves of Messrs. Stone's system, and so given the travelling public another concession which is the one thing required to make that almost perfect line approach still more nearly to absolute perfection.

POLYPHASE DISTRIBUTION FOR TRAMWAY WORK

The *Street Railway Review* devoted a recent editorial to this important subject, which is of special interest on this side at the present moment. Its comments are as follows:—

"Until quite recently continuous currents have held practically exclusive sway in street railway work, and as far as can be clearly seen at present, they will contrive to hold their advantage over the alternating and polyphase distribution in the tramway service of cities and thickly populated sections, where short hauls and heavy travel are the rule. Polyphase current distribution, however, is a comparatively new factor in certain classes of railway work, which has undoubtedly come to stay, and it possesses some notable advantages in the case of suburban and interurban railways, and where cheap water-powers are available at some distance from the line of the road. A few cases are to be found abroad where polyphase currents are used direct by means of induction motors on the cars, but this method cannot yet be said to have assumed much prominence, although it is one which gives promise of important developments in the future. The general practice at present where polyphase currents are used is to generate them at one central station, the location of which is not important, as far as the cost of conductors is concerned, and at this station, if distant from the line, the current is raised to 5,000 or 6,000 volts by means of stationary step-up transformers. From the central station these high potential currents are led to transformer stations located at convenient distributing points along the railway, where the current is first reduced in voltage by means of step-down transformers, and then changed from alternating to direct in character by means of rotary transformers, giving a continuous current of 550 volts, which feeds into the trolley line.

"At first sight the losses incident to the three transformations of the current lead to the impression that such a system cannot be economical, and such would have been the case of a few years ago. In the modern types of stationary transformers, however, and especially in those of considerable size, the loss of energy is very slight, amounting to less than 2 per cent. at full load, and perhaps 4 per cent. under average conditions. The loss in the rotary converter is somewhat greater, amounting to, say, 6 or 8 per cent., which is required to overcome friction and core losses. The total efficiency of the transformations, therefore, need not fall below 80 per cent. in a properly designed plant; but even if a considerably lower efficiency is realised, the loss will be less than the drop usually allowed on long direct current lines, while the whole saving in copper, due to the use of the high potential circuit, remains to be credited to the polyphase system.

"Some examples of this method of distribution are now in evidence upon a number of roads in this country, with results which have proved highly satisfactory for the time this system has been under observation. One of the earliest examples of this system was in Lowell, Mass., where the cost of polyphase transmission was shown to be 70 per cent. of the cost of a separate direct current power station. An 18-day test of this system showed an average efficiency of 70 per cent. measured from the alternators to the direct current output of the rotary transformers, the losses including those of two sets of static transformers, the line and the rotaries. The best day's efficiency during this test was 73 per cent. The Chicago and Milwaukee Electric Railway's equipment is on this same general plan of distribution, and, although only opened for traffic over its full length for a comparatively short time, is pronounced by its engineer to have shown remarkably good results. This plant will undoubtedly show a higher efficiency than the preceding one, as the generators deliver three-phase currents directly to the converter station without the intervention of step-up transformers. The frequency of these generators is considerably lower than the general practice for combined lighting and power plants, being 25 cycles per second, while from 40 to 60 is more common, the higher number being essential where lighting is involved.

"A similar system has been introduced in Washington, D.C., where all the city and suburban lines have been consolidated under one operating company. All the lines extending beyond a certain distance from the power house are supplied with three-phase currents, and considerable economy over the former separate stations has been realised even with the temporary plant now in use. The Citizens' Traction Company, of Oshkosh, has just completed a plant of this description, and two others in course of construction for the Toledo, Fremont and Norwalk, and the Dayton and Northern roads in Ohio. Other examples of this distribution could also be mentioned, showing the growing use of this system in railway work, and it may be said that when we come to distances beyond, possibly, 15 miles, the polyphase system must be used for economical transmission.

"A farther development of this system promises to be introduced at no distant date which will add still more to the efficiency of such transmissions. This lies in the use of induction motors on the cars, which, as suggested above, has already met with some success in Europe. In this case rotary transformers are entirely dispensed with, and only static transformers are used, which not only increases the efficiency of the transformation, but dispenses with the labour of personal attendance at the converting stations. The troubles incident to commutators are also avoided, although the necessity of a double trolley system is introduced. This system was installed in Lugano, Switzerland, in 1896, at Evian-les-Bain, France, and other places, where it is working successfully.

"There are some advantages in the induction type of car motor over direct current types, one of which is the retarding action of the motors when driven beyond a certain speed by the car on down grades. They may be designed to develop a retarding force much greater than their working torque when their speed increases above the normal, and this effect takes place automatically, being inherent in the machine. The working torque may also be increased by connecting the motors in series, the torque being proportional to the number of motors so connected."

CORRESPONDENCE.

Transformer Sub-station Regulations.

A correspondent has written to us as follows:—

"Will you kindly inform me where I can find, published, the rules to be observed in construction of high tension alternating transformer sub-stations to Board of Trade requirements, and applicable to the provinces?

"The ordinary rules, so far as I can find out, barely mention the matter and give nothing definite or in detail. Surely Board of Trade inspectors must have some definite rules to adhere to.

"T. B."

[For the benefit of our correspondent and of other readers to whom the subject may be of interest, we have compiled the following notes thereon:—

The Board of Trade are given power to control the technical details of generation and distribution of electrical energy, by a clause in Provisional Orders (now embodied in the "Electric Lighting Clauses Act," just approved by Her Majesty) under title "Nature and Mode of Supply," which is of the form:—

"Energy shall be supplied only by means of some system which shall be approved in writing by the Board of Trade, and,

Subject to such regulations and conditions for securing the safety of the public and for insuring a proper and sufficient supply of energy as the Board of Trade may impose."

Taking the latter clause first, our correspondent can obtain a copy of the Board of Trade Regulations from the Corporation of his town as undertakers under their order, as it is also provided in Provisional Orders that—

"All regulations and conditions made by the Board of Trade . . . . shall, within one month after the same as made or last altered have come into force, be printed at the expense of the undertakers and . . . . copies shall also be kept by them," *i.e.*, the undertakers, "at their principal office within the area of supply and supplied to any person demanding the same at a price not exceeding sixpence for each copy."

The undertakers are liable to a daily penalty not exceeding £5 if they fail so to do.

The only other rules in force are specific or local and are embodied in the description of the "approved system of supply," as settled between the undertakers and the Board of Trade. As a general rule there is little of a technically valuable character embodied in this authorisation. As a guide to the general form which the approval takes, the following relating to the transforming plant of a London supply may be cited:—

"A high pressure alternating current supply at constant pressure to transformers, placed as a rule in converting stations, but in some instances where this is impracticable, on consumers' premises.

"It is intended to utilise cast-iron street boxes as converting stations. Each such station will contain one transformer only of a power not exceeding 30,000 watts, which, with suitable high pressure fuses, will be enclosed in a second cast-iron case standing on the base of a street box and in metallic connection with the armouring of the high pressure mains.

"The inner cast-iron case will be gas-tight and water-tight, the vacant spaces round the case being filled up with suitable material to such an extent as to prevent any danger of explosion should gas by accident obtain access.

"The converting stations will be examined at least twice in each week. Each transformer will be protected by a suitable automatic quick-acting cut-off. From the converting stations a low pressure supply at constant pressure will be given for the use of consumers."

No general rules are issued by the Board of Trade as to sub-stations. Each undertaker submits his proposals, and officers of the Board draw up a description of the system as it will be "approved," and embody in this document such special conditions as they think necessary to ensure a proper supply and secure safety. The "definite" requirements of the Board's inspectors can only be ascertained by perusing copies of the "approvals" to high pressure alternating systems at work all over the country, and as these are not made public the only course to pursue would be to request the engineers of such systems to cause copies to be made and forwarded.

Some useful information would be obtained from "The Second Interim Report of the Departmental Committee appointed by the Home Office to inquire into Dangerous Trades," "Electrical Generating Works," 1897; published by Messrs. Eyre & Spottiswoode, as a Governmental departmental paper at the cost of a few pence. A summary of the committee's "recommendations" is as follows:—

The frames of metal transformer boxes shall be efficiently earthed, and all permanent metallic parts in transformer chambers shall be connected together and to earth.

High pressure connections in transformer chambers shall be so protected that it is impossible to touch them.

Holes through which high pressure conductors pass shall be bushed with insulating material.

Switches, which can be operated from the outside for cutting off both the high pressure and low pressure connections, shall be fitted in all transformer chambers.

The designers of sub-stations would also find it advantageous to peruse the various reports of the Board of Trade inspectors upon accidents which have happened from time to time. Most of these have been given in our columns as they were issued.—Eds. Elec. Rev.]

American Engines for Electric Traction.

My attention has just been called to your issue of the Electrical Review of the 1st ult.; on page 343 the following note appears:—

"At Dudley, some engines by another maker, the Ball and Wood Company, have a distinctly light appearance, and like other American engines, lack the finish and neatness of English work."

I think that these comments on the engine, for which I am agent for Great Britain, are decidedly uncalled for, seeing that the point under discussion was purely on the "Allis" engine, and seeing that the statement is misleading, I take this opportunity of correcting you.

If you will compare weight for weight of the Ball and Wood engine with those manufactured in Great Britain, you will find that the Ball & Wood engine is far heavier; the difference I have found out in actual practice to vary from 10 up to as much as 30 per cent. in excess of English practice; under these circumstances it speaks very highly for the ingenuity of design, which supplies an engine heavier in weight with larger diameter shafts and larger wearing surfaces than is the practice on this side, and at the same time to give the engine the appearance of being flimsy.

One of the points of the Ball & Wood engine which is not found in English practice is, that the engines are capable of taking 50 per cent. momentary overloads. These engines have been running for some 10 or 12 years in the States, and in no instance has there been a single case of a broken crank-shaft, or any trouble outside ordinary wear and tear. With regard to the finish and appearance, the engine has been very highly complimented by practical experts on this side for its neatness in design, and for its massive proportions.

As regards the finish, the engines at Dudley run with an entire absence from vibration, which is shown by the fact that a penny can be placed on end on the cylinders and will remain there, and a visit to the station will prove that the Ball & Wood engines run noiselessly, and the purchasers have expressed themselves satisfied with the economy. There is no advantage in putting on finish, such as is the practice in this country in some instances, if there is to be no corresponding benefit in the working economy of the engine.

F. Nell.

[We had no intention of speaking disparagingly of these engines. We cited them merely as an instance of satisfactory engines that were not enormously heavy, as we are of opinion that the demand for excessive weight is uncalled for. We are fully aware that the Ball & Wood engine runs practically free of vibration. We fail entirely to see any cause for grievance.—Eds. Elec. Rev.]

Stresses in Engine Shafts.

Anent your recent articles and correspondence regarding the stresses in the shafts of electric generators, the following particulars which relate to the 7,500-kw. alternator, which was designed in 1888 by Mr. Ferranti for the Deptford station, may be of some interest:—This machine was designed to run at 60 revolutions per minute. The approximate weight of the revolving armature complete is 200 tons. The diameter of the shaft in the hub at centre of armature is 36 inches, and in the bearings 28 inches, with a 12-inch hole running right through. The span from centre to centre of bearings is some 14 feet 8 inches. The diameter of the crankpins is 24 inches, with a 6-inch hole running through them.

The above figures are representative of what may be taken as the best English rolling mill practice, and a comparison between these and the Glasgow dimensions is somewhat interesting.

E. J. S.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Continued from page* 523.)

The evening of Tuesday, September 5th, was signalised by a banquet given by the Swiss Electrotechnical Association and some Swiss firms to the visitors at the Tonhalle. The entertainment was most enjoyable, but the most interesting feature of the occasion was the speeches which were delivered during the evening.

Prof. Wyssling, the President of the Swiss Association, opened the proceedings with an apology for the absence of Colonel Huber, whose severe illness prevented his attendance, to his very great regret.* In the absence of the colonel, Prof. Wyssling greeted the visitors in the names of the Swiss Association, of the British Consul and Vice-Consul, of the Swiss scientific societies, and of his fatherland. Pointing to the great importance of the engineering industry to his country, he acknowledged the obligation under which it lay to English theory, on which he laid stress.

* We are glad to say that, according to latest advice, Colonel Huber is convalescent, and making good progress towards recovery.

Colonel Huber's speech was then read, in which he welcomed the Institution, and expressed his thanks to the British Minister, the president of the Town Council of Zurich, the representatives of the Polytechnic, and the directors of power stations, who had joined in welcoming the visitors. Col. Huber proceeded to explain how Prof. Thompson approached him unofficially early in the year with a view to arranging a visit, and how he at once consulted Mr. C. E. L. Brown and Prof. Wyssling, and informed Prof. Thompson that the visit would be heartily welcomed. The programme was drawn up so as to enable the visitors to obtain a general idea of Swiss activity in electrical science; while the latter is the most modern branch of industry, its development has led to great advances in the construction of prime motors, and in Switzerland this applies especially to hydraulic machinery. But even in Switzerland steam and gas motors are of great importance, for the supply of water-power, although very great, is not so abundant or so cheap as to balance the advantages possessed by other countries, especially by England. Switzerland has no coal or metal mines, and no seaports, while she is encircled by a girdle of customs duties. He welcomed in the visitors the representatives of Free Trade principles, which were carried out in Switzerland so far as conditions allowed.

Referring to the cosmopolitanism of science, which knows no fatherland, Colonel Huber hoped that the members of the party would profit by the tour, but they must allow for the difference in conditions from English circumstances. In conclusion, he hoped for closer intimacy between the Swiss and the English engineers, and proposed the toast of "The Queen," which was heartily received.

Dr. Thompson replied in a glowing speech, eulogising the prosperity of Switzerland, especially seeing that it has been attained in spite of the lack of mineral wealth, and in the face of keen competition on the part of the neighbouring States. He ascribed her success in overcoming obstacles to the fact that Switzerland "has the men"! The splendidly equipped Federal Polytechnikum had contributed largely to the success of the country; he strongly recommended all present to join in the visit of inspection on the following day. The health of the President of the Swiss Federation was then honoured.

Other toasts followed, and great efforts were made to induce Mr. Brown to speak, but he was obdurate. Mr. Crompton declared that he made a practice of picking other men's brains when he visited their works, and was heartily applauded! The majority of the English retired soon after midnight, but it was rumoured next day that our Swiss friends kept up the celebration well into the small hours, and thought us early birds!

(To be continued.)

BUSINESS NOTICES, &c.

Aluminium.—In India much is being done in the manufacture of aluminium domestic utensils, &c. According to a letter from an engineering professor at Madras, to a Madras paper, the work was originally started at the School of Arts, but there are now several other centres of manufacture, and the more general adoption of the metal is being hastened by the prevailing high prices of copper and tin. A large order for cooking vessels for the 28th Madras Infantry has recently been filled at the school. Aluminium has also recently been used as a bearing metal for shafting in the Madras College of Engineering and has proved satisfactory.

Air Brakes for Electric Cars.—The French Thomson-Houston Company has within the past week placed an order for 150 air brake equipments, and 90 air brake trailer equipments for electric motor cars. These will be of the Standard Air Brake Company's improved axle-driven compressor type as used in England on the Liverpool Corporation Tramways, the North Staffordshire Tramways, the Potteries Electric Tramways, the Bolton Corporation Tramways, the Dublin United Tramways, &c. The French Thomson-Houston Company has been a leading exponent of the principle exemplified in the magnetic disc form of electric brake, and their placing of this large order for Standard air brakes is considered to mark a significant step in the decison of the mooted question as to the relative merits of air or electric brakes for electric traction work.

Bandon (Ireland).—The *Skibbereen Eagle* says that the old project for converting the long-idle mill into "an electric works" is now being revived. The mill has abundant water-power.

Electrical Wares Exported.

Week ending Oct. 4th, 1898.		Week ending Oct. 3rd, 1899.	
Adelaide	Value £20	Adelaide. Teleg. mat.	Value £658
„ Teleg. mat.	890	Brisbane. Teleg. mat.	3,446
Aden	29	Buenos Ayres. Teleg. mat.	663
Amsterdam	102	Calcutta	694
Boca. Teleg. mat.	566	Cape Town	114
Bombay	10	Chinde. Teleg. mat.	988
Boston	40	Colombo	114
Boulogne	37	Copenhagen. Teleg. wire	26
Buenos Ayres	28	Durban	103
Calcutta	289	„ Teleg. mat.	68
Cape Town	1,718	East London	160
Cologne	387	Hamburg. Teleg. mat.	100
Demerara	51	Helsingfors	36
Durban	297	Hobart	24
„ Teleg. mat.	248	Lorenco Marques. Teleg. mat.	349
East London	207	Malta	63
Fremantle	375	Melbourne. Teleg. wire	2,033
Gothenburg	37	Montreal	70
Halifax. Teleg. cable	26,000	Oporto	45
Hong Kong	185	Perth	70
Monte Video. Teleg. wire	407	Port Amelia. Teleg. mat.	1,415
Ostend	20	„ Elizabeth	350
Para. Teleg. cable	9,000	„ Said	886
Perth	125	Rio Janeiro. Teleg. mat.	3,312
Port Elizabeth	128	Rockhampton	42
St. Petersburg. Teleg. wire	178	Rotterdam	10
Stockholm. Teleg. wire	24	St. Petersburg. Teleg. cable	99
Sydney	2,653	Shanghai	75
Yokohama	281	Sydney	817
		„ Teleg. mat.	721
		Trinidad	45
		Wellington	301
		„ Teleph. mat.	567
		Yokohama	78
Total	£44,174	Total	£17,997

Foreign Goods Transhipped.

Durban. Telephone	£30	Antwerp. Elec. machinery	Value £50
		Port Amelia. Teleg. wire	920
Total	£30	Total	£970

The Art of Illustrating.—The process block is among the modern improvements in the production of high class magazines and trade journals, but modernity notwithstanding, the up-to-date editor knows that few things are more essential. Interest in processed illustrations is not however confined to the editorial sanctum, for the business man who is ever striving to outrival his competitors in the production of catalogues and price lists and by the extent and frequency of his advertisments, must keep in mind the necessity for good pictures wherewith to embellish his productions. There was a time when we used to turn to the pages of American journals for interestingly arranged advertisments, but during the past few years we have witnessed an improvement in those appearing in English periodicals, and the process block has performed its part in bringing about the change. For the benefit of those who are anxious to see some good specimens of such work, we may mention that Messrs. Penrose & Co., of Upper Baker Street, W.C., have issued their pictorial annual for 1899, with the title the *Process Year Book* (a review of the graphic arts). Mr. Wm. Gamble is the editor of the publication, which like previous issues is well worth a study. We can hardly afford space to mention the many excellent works of art from which reproductions have been made by half-tone copper and zinc etchings, three colour printing, photo-chromotype, collotype, and other processes, but a perusal of them shows what excellent effects may be obtained. In addition to the pictorial part of the book there are a number of useful articles on the technics of process work and printing by various writers.

Bankruptcy Proceedings.—The first meeting of creditors was held on Tuesday at the London Bankruptcy Court under the failure of Frederick G. W. J. Adams, electrical engineer, lately trading in partnership with C. M. Downie, at 24, Newman Street, Oxford Street, as Downie & Adams. The debtor ascribes his position to his liability for the partnership debts, which he estimates at £1,700 and states that the business was carried on for 2½ years up to last June. There was considerable discussion as to the best way to administer the estate, and eventually the case was left in the hands of the Official Receiver to be wound up in bankruptcy. It was intimated by a creditor that in order to facilitate the proceedings he would apply for a receiving order to be made against Mr. Downie.

Books Received.—"Fire Tests with Glass."—(1) The casements glazed by the British Prism Syndicate, Limited; (2) two skylights glazed with wired glass by Messrs. Pilkington Bros., Limited. London, 1899: The British Fire Prevention Committee. 2s. 6d. each.

"Quarterly Journal of the Royal Meteorological Society." London Edward Stanford. 5s.

"Practical Magnetism and Electricity," by J. R. Ashworth. London: Whittaker & Co. Second Edition. 2s. 6d.

"Electric Wiring, Fitting, Switches, and Lamps," by W. P. Maycock. London: Whittaker & Co. 6s.

"Arc Lamps," by H. Smithson and E. R. Sharpe. London: Whittaker & Co. 1s.

"Engineering Magazine." London: 225, Strand. 1s.

Catalogues.—Messrs. Alldays & Onions Pneumatic Engineering Co., Limited, of Birmingham and London, have issued two excellently prepared sections of their catalogue. Section (X) is an illustrated list of turbines of improved types, in which the construction of the machines is explained by the aid of some very neat diagrammatic and other sketches. In tabulated form we find dimensions, &c., of horizontal shaft Girard turbines of various sizes from 11 to 31 inches, there are also notes of low and medium fall

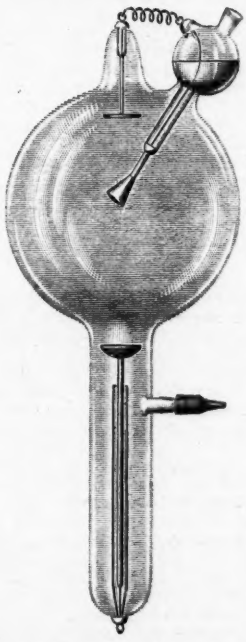
Girard types, Pelton wheels for 100 to 260 feet falls, horizontal shaft Jonval turbines, accompanied by first class explanatory drawings. The remainder of the list is taken up largely with general information regarding water-power. Section (Y) list, which is also arranged and illustrated in a very creditable manner, deals with improved blowing, exhaust, ventilating and pressure fans, together with a large amount of general information, valuable to fan users. The direct electric motor driven fan finds a place in the catalogue.

From Mr. G. Braulik, of Upper Thames Street, we have received a priced catalogue of his latest electrical fittings. The list is in fact an electrical supplies catalogue covering almost all the likely requirements of the trade. The aid of the illustrator has been called in somewhat extensively, for the book abounds in cuts showing the various switchboards, switches, lamp fittings, measuring instruments, linemen's tools, electric heating apparatus, telephone equipments, &c.

Deed of Assignment.—A deed of assignment has been executed by W. P. Mendham (trading as Mendham & Co., at Bristol), with various creditors. Mr. E. T. Collins is the trustee. It is stated that the accounts show that the deficiency is largely due to a heavy loss made under his dissolution arrangements with his late partner, Mr. King, and to losses on subsequent trading. The summary of affairs shows a deficiency of £3,228 13s. 7d.

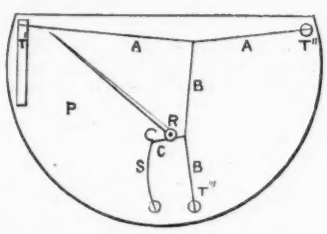
For Quick Delivery.—We believe that it is not very usual in these times of full order books and congested works for large electrical contracts to be completed under the time stipulated when the orders are placed. But a case which has just been brought to our notice shows what English firms can do when they are given the opportunity. The Atbara Bridge and other recent contracts placed with American firms, seemed to indicate that quick delivery of new work must not be expected at present; but it is pleasing to be able to record an instance of quick delivery of electrical equipment of the Burma Ruby Mines. About the middle of July Messrs. Johnson & Phillips, who received the contract, thought that delivery might be given within five months, but as Sir Lepel H. Griffin, the chairman of the mines, brought pressure to bear upon the firm and quoted "Atbara!" Messrs. Johnson and Phillips buckled-to with a will to show what they could do, with the result that the whole of the material was despatched within six weeks. This is undoubtedly a very creditable performance, but it occurs to us that when contractors quote they ought to be able to state pretty accurately when the machinery can be ready, for in nine cases out of ten if the time promised for delivery were a month or so longer than another house offered, "Atbara!" would not be uttered as a warning note, but the contract be straightway given over to the foreign rival. On the other hand, we think that making quick delivery promises which one has no prospect of fulfilling is to be more strongly condemned. The evils resulting from such a course have been clearly shown of recent years both in the electrical trade and out of it.

New Vacuum Tube.—Since the discovery of the electrolytic interrupter for use with X ray work, one of the difficulties has been to find tubes suitable to stand the current. Messrs. Harry W. Cox, Limited, of Cursitor Street, Chancery Lane, the well-known manufacturers of X ray apparatus, are now making tubes which have been specially designed and patented to work with the electrolytic break. The tube, as shown in sketch, has a cone-shaped anode



which is hollow. Into the small glass bulb at the top of the anode is poured a little cold water which fills the hollow anode so that when working the water prevents the anode from melting, with the result that a much stronger current may be used. The results on the screen are stated to be excellent, and the time to take a radiograph is greatly reduced.

Hot-Wire Ammeters and Voltmeters.—Messrs. Johnson & Phillips inform us that they have acquired the sole rights of manufacture and sale in the United Kingdom of the Hartmann and Braun patent hot-wire instruments, which are widely used on the Continent and in this country by those who are "in the know." The instruments are being manufactured in their entirety by Messrs. Johnson & Phillips, under the superintendence of an experienced assistant. They are equal in every respect to the original pattern, the only alteration being in their external appearance, which is modified to conform with English usage. In these instruments the heating effect of the electric current in a wire of suitable resistance is by special mechanism made to serve the purpose of indicating current or pressure in the measuring apparatus. The quantity of heat developed by unit current in unit time is the same for every kind of current, continuous or alternating (of any frequency), and is quite independent of the phase or method of generation. The instruments are absolutely unaffected by magnetic fields, and not having a solenoid, are, of course, entirely free from self-induction. The measuring or hot wire, A A, is of platinum silver, 160 millimetres long, which is stretched between two terminals, T', T''. In the centre of this wire another wire of phosphor bronze, B B, is attached at right angles, and held taut by a third terminal, T'''. Near



the centre of this phosphor bronze wire a cocoon fibre, C, is fixed by one end at right angles, the other end passing round a specially grooved metal roller, R, fixed on a pivoted steel spindle mounted in jewels, and finally terminating in a small eyelet attachment to a flat steel spring, S. The whole arrangement of the fibre and wires is thus subjected to tension, and any slackening or "sag" of the measuring wire is immediately taken up by the steel spring, and is transmitted by the phosphor bronze wire and fibre to the grooved roller which carries the pointer. By this method the smallest extension of the wire is very greatly magnified and conveyed to the pointer, thus rendering the deflections easily perceptible. Another advantage of this construction is, that the scale has larger divisions in the part most frequently needed. That the instruments may be used for accurate laboratory work is affirmed by the Imperial Physical Laboratory, Berlin, where a large number are in use; they are also employed at the Central Technical College, London. The whole of the hot wire movement is mounted on a metal compensation plate, P, made from a carefully tested alloy, whose temperature coefficient is the same as that of the measuring wire. To deflect the pointer of the voltmeter over the full scale, a current of 0·2 ampere is required. For ranges up to 400 volts, a series resistance of constantin is placed in the backs of the instruments, where special means are provided for efficient ventilation. For higher ranges than 400 volts the resistance is placed in a separate case. In the ammeters the hot wire is divided into equal parallel parts of two or four, by thin silver foil strips; by this means 4 or 5 amperes may be sent through the wire with a drop of potential not exceeding ·25 volt. All the ammeters are provided with a constantin shunt, which, when the range does not exceed 100 amperes, is placed in the back of the instrument. For higher ranges the shunts are separate, and may be had to carry several thousand amperes. The instruments are exactly similar, except that a thicker hot wire is used in the ammeter than in the voltmeter, and a shunt substituted in the former for the resistance in the latter. They, moreover, absorb comparatively little energy; a thin metal plate situated near the hot wire protects the latter from air disturbances and insures a uniform heating of the wire. This is a distinct advantage over other instruments of the same type. A magnetic damping arrangement is provided, thus rendering the instrument dead-beat and without the unpleasant oscillations so common to most instruments due to a sudden rise or fall in the current, and the pointer is in perfect equilibrium in every part of the scale. For high pressure the whole internal mechanism is mounted on ebonite, the cover being also made from the same material. The instruments may be had with either front or back connections, and for central station work the usual large type can be supplied with illuminated dial. The portable instruments are mounted in strong oak cases and fitted with plug fuses to prevent damage by any accidental excess of current. Means are provided to reset the pointer to the zero position should it at any time show a zero error. Having had considerable practical experience with these instruments, we have formed a high opinion of them, especially as ammeters for alternating currents; in this capacity we believe them to be unexcelled.

The Jerry Wirer at Buenos Ayres.—The jerry wirer is to be found wherever electric lighting makes its way. We have already referred to his predations at Buenos Ayres, and we now read that his doings are by no means at an end there, any more than they are here at home. The *Review of the River Plate*, which has concerned

itself with the evil, returns to the subject in a recent issue in the following terms:—

"A case came to our notice the other day which shows how strict inspectors have to be in overhauling electric light installations, both parts exposed to view as well as those hidden away in casing. It appears that several of the numerous tinkers who call themselves electricians are accustomed to put in good wire at all points within reach of the inspector, all that out of reach being merely cotton-covered wire. This accounts for how some men are able to put in installations as low as two dollars gold. The average shopman will take the cheapest he can get, and knows nothing about the quality until the trick is discovered, and he has to have the whole installation done over again. We think that the electric light companies would do well to make a note of those installers whose work is refused by the inspectors, and if it is found that they are continuing with their bad work, they should be warned off. This can be done by combination on the part of the companies, as the entire question of good or bad wiring lies with them, and the sooner that the bad wirer is scotched the better for all; but we are much afraid that we shall have him with us for some considerable time, if not for ever.

"A party of members of the Institution of Engineers at Buenos Ayres has had a debate on the house wiring question. It was generally acknowledged that there was plenty of room for improvement in the average work of the present day. It was further pointed out that the majority of bad work was to be found concealed in wood casing, and also in piping in the walls, when the installation had not been carried out by firms of any standing."

Liquidations, Dissolutions, &c.—The Tramways Union Company, Limited, is winding up voluntarily. Messrs. E. M. Underdown, J. B. Concanon, G. Richardson, and W. G. Woolston (directors), have been appointed liquidators.

Creditors of the Dargue Acetylene Gas and Electrical Company, Limited, are required to send their names and the usual information to the liquidator, Mr. W. H. Dargue, 57, Grey Street, Newcastle-upon-Tyne, the liquidator, by November 15th. The company is winding-up voluntarily for the purpose of its transference to a new company now registering (the Dargue Acetylene Gas Company).

Creditors of the Electric Lighting Extension Syndicate must send particulars of debts, &c., to Mr. C. O. Bastian (Bartholomew Works, Lawford Road, Kentish Town, N.W.), the liquidator, by November 12th.

A meeting of the Niagara Battery Company will be held on Monday, November 6th, to receive an account of the winding-up from the liquidator (Mr. F. Offor).

Messrs. C. T. Briscoe and E. Jones (Briscoe & Jones, electrical engineers and contractors, Richmond Terrace, Blackburn), have dissolved partnership as from July 31st.

Messrs. C. Allen and H. E. Fiford (Fiford & Co, electrical engineers, 94, New Road, Southampton) have dissolved partnership. Mr. Allen will attend to debts, &c.

Notice is given in the *London Gazette* of release of trustee (Mr. E. L. Hough, official receiver), in the case of E. S. D'Oliardi, medical electrician, of Silver Street, Notting Hill, &c.

McNeill's Code.—The publishers (Whitehead, Morris & Co.) inform us that Mr. Bedford McNeill's Mining and General Telegraphic Code has been extensively adopted in all the more important mining centres throughout the world. The book is now rendered still more serviceable by the publication of an extra part consisting of a "terminal index." This index permits of quickly determining the possible alternatives to any mutilated cipher word. So long as the termination only of a cipher word is mutilated, no great loss of time occurs owing to the alphabetical arrangement of the code itself, but when the beginning of a cipher word is wrongly transmitted much valuable time may be lost. The "terminal index" will prove invaluable in preventing this loss of time.

Motor Controllers.—The Ward-Leonard Electric Co., of Bronxville, N.Y., U.S.A., have just produced several new types of instruments. Principal among these are the HR and HV types. In this type of instrument the lever-bearing magnet keeper is released at failure of current, delivering a hammer blow to the main controlling switch lever, and driving the same to the position of open circuit. The HR type is for reducing to half the speed a motor whose torque is constant at all speeds; for example, a motor driving shafting. The HV type has a two to one gradation in ampere capacity and is intended for reducing to half the speed of a motor driving a ventilating fan.

A New York View of the Copper Situation.—From some notes in the last issue of the *Electrical World* to hand, it seems that the outlook for cheaper prices of copper is promising. Promises are received from many quarters, as the inevitable result of the development of production in various mines. Among the most formidable of these are the great copper mines of Rowan and Cabarrus Counties, North Carolina, which furnished all of the copper used by the Confederacy, and which are rich enough in ores, it is said, to supply the world's demand for years. These mines were originally worked for gold exclusively, and were abandoned entirely not long after the close of the war. Boston and New York capitalists, supposed to be backed by great electrical interests, bought them for a song, and have organized the Union Copper Mining Company, under the laws of New Jersey, for the purpose of operating them. The capital of the company is only $3,000,000, but it has already begun the erection of an extensive plant, and by January 1st next will be producing 1,000 tons of ore a day, which will yield 200,000 lbs. of pure copper a day. The company purposes to market the copper in New York at 10 cents a pound, which will give it a profit of 4 cents a pound. "There is no question that the claims of the copper pool that it can regulate the copper production of the United States and hold the price of copper at present rates are utterly absurd," said Walter G. Newman, president of the Union Copper Company. "We can market copper profitably at 10 cents a pound in New York, and there are new mines being constantly opened."

Partnership.—Prof. A. B. W. Kennedy intimates that he has taken into partnership, as from October 1st, Mr. Bernard Maxwell Jenkin, who has for some years past been his principal assistant at 17, Victoria Street, S.W.

Raw Hide Gear Wheels.—We have received from Mr. W. F. Dixon, 63, Percival Street, Manchester, particulars of his improved metal bushed buffalo raw hide gear wheels for noiseless driving. By an improved process he obtains a wheel which is practically a solid block of raw hide of any desired thickness. Pinions are built up in layers on a metal bush with lugs finished externally with a plain ring. A special medium is used to attain adherence and the teeth are then machine cut. Samples seen by our representative showed in the finished wheel a remarkably homogeneous texture more resembling hardened horn than built-up hide. In the same material and by the same process he is also producing insulators, clips, &c., for electrical work. Mr. Dixon claims to produce his hide gears as quickly as metal wheels.

Reduction of Capital.—A petition has been presented to the Chancery Division for confirming a resolution reducing the capital of Messrs. Hick, Hargreaves & Co., by returning to the shareholders £2 per share on the understanding that the amount may be again called up.

Soldering Tools.—Mr. J. W. Manley has designed (and Messrs. W. Tasker & Sons, of 39, Victoria Street, S.W., are selling) the "Moto" soldering tools for use in the construction of trolley, telegraph and telephone lines. These tools have been designed to meet a need which has existed among electricians. For use in electric tramway work, we understand that the "Moto" tools have been adopted by the British Electric Traction Company, also for use in connection with the West Hartlepool, Bristol, and London United Tramways Company, and their employment has given satisfaction. The tools are also made with straight copper bits for soldering armature connections and for general purposes. The bits are made in three sizes weighing 3 ozs., 11 ozs., and 1¾ lbs. Special sizes and shapes are made to meet requirements.

The South Western Polytechnic, Chelsea.—The Day College for Men, the Day College for Women, and the evening classes commenced on September 25th. Full particulars of all these classes may be obtained from the Secretary, Manresa Road, Chelsea.

Trade Announcements.—Messrs. J. E. Spagnoletti and Crookes inform us that the Alliance Fire Apparatus Company, Limited, which was noticed in our last issue, has been formed to take over the fire apparatus business which has been a small branch with them for the last 18 months. As the Articles of Association of Companies at the present time have such a wide range, they have included electrical and mechanical engineering, but we are asked to state that the Alliance Fire Apparatus Company is in no way connected with Messrs. Spagnoletti's ordinary business of electrical and mechanical engineers.

Messrs. Speedy, Congdon & Co., of 14, Victoria Street, S.W., announce that Mr. G. H. Congdon retired from the firm in August, and all debts, &c., will be attended to by the remaining partners, who will continue the business under the style of Speedy, Eynon and Co.

Mr. R. C. Sharp and A. O'Brien have dissolved partnership by mutual consent, and Mr. O'Brien announces that he will continue the business of English and American gas, steam, and water tubes merchant on his own account as O'Brien & Co., at 62 and 63, Minories, E.C. Debts of the old firm will be paid by him.

Messrs. H. Pickford & Co., have taken over the business of electrical and general engineers carried on for nearly 20 years by Mr. F. Ingram at 21 and 25, Leader Street, Chelsea. Mr. H. H. Pickford, A.I.E.E., will have charge of the electrical department at 21, Leader Street.

Messrs. A. Gray & Co., wood turners, have removed from Ladywood Road, Sparkbrook, to Breedon Cross Saw Mills, Stirchley, near Birmingham, where they will continue the manufacture of switch-blocks, boards and boxes, &c.

Turbine Works at Leeds.—The winter session of the Leeds Association of Engineers was opened on Thursday last week, when the president (Mr. Joe A. Tempest) delivered an address. Alluding to the prosperous state of the engineering trade, he referred to the enormous increase in the cost of raw materials, and trusted the demand for the finished product would justify them in asking such advanced prices as would cover the extra cost of production. He alluded to the latest engineering industry introduced into the city by Messrs. Greenwood & Batley Limited—namely, the manufacture of the De Laval steam turbines, turbine dynamos, turbine pumps, turbine fans, &c., and said that special works were being erected, having an area of nearly an acre, entirely under cover. The motive power was obtained from a 100 H.P. steam turbine dynamo (to be afterwards supplemented by two more), steam being supplied by a 10 ft. 6 in. × 10 ft. 6 in. marine type boiler with induced draught, (Ellis and Eave's patent). A surface condenser of very large capacity is provided, so that all the steam turbine motors may be submitted to an exhaustive test under working conditions before being sent out of the works. The shops will be equipped with machine tools specially designed for the economic machining of the various parts, and the larger tools will have separate electric motors to each machine; the lighter tools will be driven in groups from an electrically driven countershaft. The larger overhead cranes will also be electrically driven, and a light railway will run throughout the works to facilitate transmission of material and finished machines.

ELECTRIC LIGHTING NOTES.

Austria.—The Austrian Union Electrical Company, of Vienna, is about to establish a large central station at Schatzlor for the supply of electrical energy for lighting and power purposes within a radius of 35 kilometres.

Berwick.—Mr. Campbell Swinton met two Committees of the Town Council on Tuesday afternoon and conferred as to the electric lighting of the town.

Birkenhead.—The Watch Committee approves of the Lighting Sub-Committee's report that the use of incandescent gas for street lighting be extended to 13 of the principal streets.

Bombay.—In a letter to the Corporation, according to the *Times of India*, the Municipal Commissioner, Mr. W. L. Harvey, states that three electrical firms are applying for leave to undertake electricity supply in the city; there is at present no public supply, nor has there been any attempt to introduce electricity into the city since the collapse of the Eastern Electric Light and Power Company. The applicants referred to are Messrs. Killich, Nixon and Co. (representing Callender's Cable and Construction Company), Turner, Hoar & Co. (agents for Siemens Bros. & Co.), and Mr. J. B. Foster. The first-named firm has priority in order of application, but the Commissioner understood that Messrs. Turner, Hoar & Co.'s scheme was in the more advanced condition.

Bridlington.—The District Council has resolved to apply to the Board of Trade for a provisional order under the Electric Lighting Act, 1892, to enable the Council to supply electricity for public or private purposes within the area of the district.

Brierley Hill.—The District Council on Monday last decided to make application to the Board of Trade for a provisional order under the Electric Lighting Acts to authorise them to supply electricity for public or private purposes.

Brighton.—The Town Council has adopted the recommendations of Mr. Wright, advising the erection of a new 25,000-H.P. station on a site at Aldrington Basin.

Chelmsford.—The Town Council having given the electric lighting company notice that the supply of water to the works would have to be discontinued after one month, the company has, very naturally, complained of the short notice, and suggested that the Council had been remiss in not providing properly for the requirements of the town. The company, however, has decided to lease a well in the meantime, and has asked for an extension of the notice, which expired on September 29th.

The Council has expressed dissatisfaction on account of recent alleged failures of the electricity supply, and is considering whether or not to apply for powers on its own behalf.

Cleethorpes.—The Electric Lighting Committee of the District Council have decided to recommend the lighting of the whole of the town by electricity with arc lamps.

Crewe.—The Town Council a short time ago obtained sanction from the Local Government Board to borrow £26,000 for the borough. As the Co-operative Stores are setting up an independent installation for their own premises, Messrs. Hopkinson and Talbot, engineers for the Corporation scheme, advise the Council to enlarge their radius, and borrow an additional £8,000.

Dartmouth.—The Town Council, acting on the suggestion of Oldham Corporation, has passed a resolution in favour of reducing the cost of obtaining provisional orders. The Edmundson Electricity Supply Company having objected to the Council's proposal to have the option of purchasing the undertaking at cost after 14 years, the Council agreed to purchase at a valuation.

Eastbourne.—The Electric Lighting Committee recommends the Council to appoint Mr. John Kempe Brydges (Wakefield) as resident electrical engineer for the borough.

Gloucester.—The City Council has found it necessary to consider the question of extensions of the electric lighting plant already, although the supply has not yet commenced. Mr. Hammond, the consulting engineer, is to report on the matter. The Council has entered into an agreement with the National Electric Wiring Company, Limited, for the wiring of private houses.

Grantham.—On Wednesday the Town Council decided to obtain professional advice before taking active steps with reference to adopting the electric light for the borough.

Grimsby.—The foundation stone of the electricity works was laid yesterday, with much ceremony and the usual luncheon.

Hythe.—The Folkestone Electrical Supply Company, having declined to alter their terms for supplying the town with electric light, the Town Council have decided to consider the question of applying for powers.

Ilford.—The District Council has applied to the Local Government Board for powers to borrow £68,000 for the purpose of lighting the area under its control by electricity.

Italy.—The prefectural authorities of Verona have received an application for a concession to utilise the water-power of the Adige in the generation of electrical energy and for the distribution of the same. It is said that 5,000 H.P. is available.

Inverness.—The Town Council last week resolved that the plans and specifications submitted by Mr. Craven, electrical engineer, for the electric lighting of the town be remitted to Messrs. Kincaid, Waller & Manville to examine and report. The plant to be laid down, which was to cost the town from £20,000 to £25,000, would be sufficient to light the whole of the town.

Lancaster.—The Local Government Board is prepared to grant a provisional order including only those parts of Scotforth, Skerton, and Bulk as were applied for in 1888, instead of the whole as applied for, on the ground that the incorporation of such large areas was unusual. But is it therefore wrong?

London, E.C.—At the Farringdon Ward Club on Wednesday last week Mr. A. C. Morton delivered an address on the electric lighting in the City. After saying that the matter was still *sub judice*, preventing his dealing freely with it in an outspoken manner, he proceeded to deliver a rigmarole covering as many points as possible in this now wearisome controversy. The views of the Board of Trade and Sir Courtenay Boyle favouring a competitive supply as a means of improving the City supply were supported by Mr. Morton, the advantages of a cheap supply of electricity dwelt upon, also the injustice of the gas authorities in charging so high a price for their commodity on the North side of London. He referred to the enormous depreciation in the market value of the shares of the City of London Electric Lighting Company, and while he regretted this he maintained that it was the duty of the Corporation to study the public interests of the entire City before those of a body of private shareholders. Mr. Morton, in referring to the great advantages of a plentiful and cheap supply of electricity, said that the City ought "to join itself to some other public lighting district where there was a resident population, which, requiring light through the night as well as through the day, would make the supply doubly remunerative to the company, and, therefore, available to the public at reduced rates." It would be interesting to know what, if any, district Mr. Morton had in mind in making these mysterious remarks at the conclusion of his speech. We have quoted them from the *City Press* report, and we are tempted to suppose that somewhere near London there is an underground residential district whose inhabitants require "light through the night as well as through the day." Truly, an ideal supply system this would be, 24 hours continuous lighting at full load, more or less! We imagine the City of London Company would be very happy if it had a steady supply for a few hours each evening instead of its sudden rise and its sudden drop. It is somewhat amusing to read Mr. Morton's comment that the matter was *sub judice*. Evidently he imagined that such being the case it was an opportune moment to deliver himself of an oration upon many of the difficult points which have arisen in connection with the City supply. He promised to abstain from outspokenness, therefore, presumably to his own mind, in keeping that promise he contended that if members of the Corporation, when acting as trustees for the public, did wrong, they should be punished, and he held also that the Court should do its best to controvert the action of the wrong-doing member. Personally, therefore, he regretted that the Court of Aldermen had not taken action against the prime mover in the transactions he had referred to. We tremble to think what language is used by Mr. Morton when he allows himself to be outspoken! Many of Mr. Morton's remarks are criticised in the *City Press*, of Wednesday, by Mr. J. W. Martin. Mr. Martin advocates the termination of the controversy by the Corporation purchasing the City Company's undertaking.

The *City Press* says that the Streets Committee will bring up a report on an offer by the City of London Electric Lighting Company to reduce the price of the current. The consumer is to be given the right to choose which of two methods of charging he prefers. The same committee will recommend that the alteration of the standard pressure from 100 volts to 200 volts should be complied with, subject to the City of London Electric Lighting Company agreeing:—

(1) To make, at their own expense, the necessary alterations to consumers' lamps, wires or fittings, directly or indirectly incidental to such change: and (2) that the prices of supply shall at no time be raised above those contained in the notice issued by the company and dated July 26th last; and (3) to establish, concurrently with the alteration of the pressure, proper means of testing the public and private supply.

Macclesfield.—The Gas Committee will not, in the meantime, consent to the application of the Electric Power Distribution Company, *re* electric lighting, but will consult an electrical expert.

Manchester.—At Wednesday's City Council meeting, Alderman Higginbottom, in reply to inquiries as to the recent frequent failures of the electric light and the disturbance of foot paths for the renewal of cable, said that originally the Corporation adopted rubber-covered cables. Time had shown that the cables had depreciated seriously throughout the city. They began to give way about 12 months' ago, and after a careful examination it was found that they were incapable of bearing the pressure. A new system was adopted, and many new cables had been laid, none of which had caused accidents at present. There were still about 12 miles of cable to be renewed. A discussion ensued on the tramway question. After a long discussion, it was decided, with two dissentients, that the Committee should apply to the Board of Trade for sanction to borrow the sum of £860,000 for the purposes indicated in our "Traction Notes" to-day.

Norton.—Messrs. O'Gorman & Cozens-Hardy have reported to the District Council that an electric lighting scheme could be carried out at a cost of about £10,000, and recommended that a provisional order be applied for.

Paisley.—The electric lighting authority has decided to purchase an Adamson engine, with Ferranti alternator, for the electric light works. The reason for purchasing an additional engine

is that the electric light department is already overloaded with orders for supply, and it is absolutely necessary that the machinery should be extended.

Newcastle.—The City Lighting Committee of the Corporation have received an offer from the Electric Supply Company to supply public lighting at the annual cost of £15 10s. per arc lamp, as against the offer of the Tramways Committee, viz., £16 3s. 4d. A sub-committee was appointed to deal with the matter.

Poplar.—The District Board has resolved to provide accommodation for a house-wiring department at the electricity works, at a cost of £1,200. The space is required for stores and showrooms. The principle involved in this step appears to us to be highly objectionable on various grounds. There is a limit beyond which municipal trading should not be carried, and this is overstepped as soon as the local authority enters into competition with its own ratepayers, with the intention of carrying out work at little above cost price. There is no question of preventing a monopoly here; on the contrary, competition is crushed. The adoption of this principle at once throws open the door for municipal groceries, tailoring, &c.—if one, why not the others?

The Board has come to terms with the dock companies for wayleaves for electric cables.

Redditch.—The Urban Council on Tuesday decided to apply to the Local Government Board for permission to borrow £7,000 for necessary works in connection with the public electric lighting and contemplated extensions.

Redruth.—Mr. Trentham has been instructed by the Urban District Council to report on electric lighting for the town.

Rhyl.—Messrs. Trentham & Preece have submitted a scheme for the lighting of the Promenade with 19 arc lamps, at a cost of £3,800, as well as a more comprehensive scheme, costing £14,000.

Saltburn.—Last year a scheme was considered by the District Council for the electric lighting of the district, at an estimated cost of £9,000, but it was shelved. According to the *Saltburn Times*, the Cleveland and South Durham Assets Company, Limited, has now taken up the matter, and has erected a supply station on its own account. The motive power is obtained from a gas-producing plant capable of supplying 5,000 lamps, but engines and dynamos are at present installed for 2,000 only. The price of supply is 6d. per unit., and it is singular to note that the maximum load will occur in August and September! Supply will be commenced in a few days.

Shoreditch.—It had been expected at Tuesday's meeting of the Vestry that a discussion would have taken place on the accounts of the electricity and refuse destructor undertaking for the past year. This anticipation was, however, not fulfilled, in consequence of the slight indisposition of Mr. N. Moss, chairman of the Lighting Committee, whose hoarseness prevented his introducing the subject on that occasion. The Vestry clerk read a letter from Mr. H. E. Kershaw, resigning his position on the Lighting Committee, partly on the ground of a statement said to have been made that he was "actuated by personal motives in advocating one make of cable over another." It was moved by Mr. Wells and seconded that the resignation should be accepted, and to this an amendment was proposed by Mr. Johnson that Mr. Kershaw should be asked to reconsider his decision. A somewhat personal discussion ensued, but in the end the amendment was adopted by a large majority. A letter from the clerk to the Shoreditch Guardians was read, expressing regret at the refusal to allow the Vestry's electrical engineer to prepare a specification for the electric lighting of the Hornchurch Cottage Homes, and intimating the intention of the board to obtain the services of other advisers. On the recommendation of the Lighting Committee the Vestry resolved to insure the six new boilers, steam pipes and economisers with the National Boiler Insurance Company, and to approve new wiring rules, prepared by Mr. Newton Russell, the chief electrical engineer.

Sittingbourne.—The District Council last week decided to apply to the Board of Trade for a provisional order to enable the Council to introduce electricity into the town and district.

Stockton.—At Tuesday's Council meeting it was stated that progress had been made with the electric lighting works, and applications are to be invited for a resident engineer at about £250 a year.

Stoke-on-Trent.—The Town Council has decided to adopt a low pressure direct current supply, and has chosen a site for the works where coal and water are easily available. Mr. J. N. Shoolbred has been asked to report on the matter.

Sunderland.—The tenders for the erection of boiler house, &c., for the electricity works extensions are considerably in excess of the borough engineer's estimates. The contract is to be given to Mr. Elrick for completion by November 7th, but if he cannot complete by then, the work will have to be done by Corporation employés under the engineer's supervision.

Torquay.—An inquiry was held last week by Major-General H. D. Crozier, R.E., on behalf of the Local Government Board, relative to the Town Council's application for leave to borrow £10,000 for electric lighting purposes. The original loan was £22,300, which was exceeded by £2,659, on account of a change in the position of the boilers at the generating station. The inspector made searching inquiries into the cause and exact amount of the loss, and expressed much dissatisfaction at the vague and indefinite testimony of the officials.

Todmorden.—At a recent meeting of the Town Council, according to the local paper, the chairman read 12 applications from electrical engineers offering their services to report on electricity for lighting and motive power within the borough, and it was resolved that a tabulated list of all the applications be prepared, printed, and sent to each member of the Committee, giving particulars of experience, &c. Comment is hardly necessary.

Ventnor.—The offer of the Electric Light and Power Company to light the streets of Ventnor by electricity was accepted by the District Council, provided the company would reduce the price quoted for the 24 arc lamps from £16 10s, to £15 each per annum. The company has consented to the reduction, so that the matter is finally settled, and the town in the near future will be lighted entirely by electricity.

West Bromwich.—The General Purposes Committee of the Town Council have considered the report of the engineer with regard to the laying down of plant for supplying the borough with electricity, and have decided to recommend the Town Council to make application to the Local Government Board for permission to borrow £30,000 to be expended in plant and mains for lighting and motive power purposes.

West Ham.—The Town Council has agreed to a report of the Public Health Committee recommending that the Dagenham Hospital be electrically lighted.

Withnell.—The Urban District Council having received a scheme for a gas supply for the district, have requested Mr. G. R. Peers, of Manchester, to prepare a scheme of electric lighting to be worked in conjunction with the sewerage scheme.

Woodford.—The District Council last week received a letter from Messrs. Taylor & Field, who stated that they had been in communication with the Buckhurst Hill Urban Council with reference to an electricity supply scheme, and that Council had viewed the proposal favourably. They now wanted to know whether the Woodford Council were favourable to a scheme for the Woodford district. The letter was referred to the General Purposes Committee.

York.—The Electric Lighting Committee of the City Council expects to commence supply in two months' time. The charges will be 7d. per unit for the first hour, and 3d. afterwards; for power, 3d. per unit will be charged.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aston.—The General Purposes Committee recommends the District Council to take over the Aston sections of the tramways of the Birmingham and Aston Tramways Company, and the City of Birmingham Tramways Company, at the times allowed for purchase in the Tramways Act. A change in the mode of traction will then be made.

Belfast.—The deputation appointed to visit other large towns regarding the laying of the proposed tramway extensions, intimated that last week they were now in a position to hand in their report, and it was arranged that a special meeting of the Improvement and Electric Committee should be held to consider the report.

Blackpool.—A man, with a child in his arms, alighted from an electric car while it was in motion; in fact, when it was negotiating a curve. He was caught by the wheels and killed, nearly every limb being broken.

Blackpool-Morecambe.—The Mayor of Lancaster, at the last meeting of the Lancaster Town Council, expressed the hope that the proposed electric railway from Knot End, to complete the Coast electric line from Blackpool to Morecambe, would not be altogether dropped. The Corporation hoped the scheme would go on, but could not consent to interference with the navigation of the river. If a detour were made through Lancaster to Morecambe, it is believed the Corporation would enthusiastically support the scheme.

Brighton.—The tramways question came up at the last Council meeting. Mr. Kincaid, the engineer engaged by the Council to advise them on the question, had prepared a detailed report on a system of tramways for Brighton. Having considered this report, the Tramways Committee recommended that the northern termination of the line of tramway in Ditchling Road be at the Drove Road, and that of the tramway in the Lewes Road be at the Ship Inn, and that, subject to these arrangements, the suggestions contained in the report of Mr. Kincaid be approved of and acted upon. Application should be made, they advised, for powers to purchase compulsorily, if necessary, for the purposes of the scheme, the premises at the junction of Viaduct Road and Besconsfield Road, formerly Longhurst's brewery and malthouse. Application should be made for authority to appropriate a strip of the Level, and a request made to the Waterworks Committee to permit the piece of land belonging to the Corporation on the north side of the Lewes Road pumping station to be appropriated for the purposes of a tramcar station. The report was adopted.

(*Continued on page* 563.)

CARLISLE CORPORATION ELECTRICITY WORKS.

That the ancient cathedral town of Carlisle is possessed of youthful vigour and prosperity is well shown by the fact that the Corporation has adopted electricity supply and electric traction (the latter through a company) with businesslike thoroughness, while the inhabitants have done their share by promptly connecting over 7,000 lamps (equivalent 8 c.p.), the number which it was estimated would *ultimately* be required, within six months of the commencement of supply, and applying for 1,300 more!

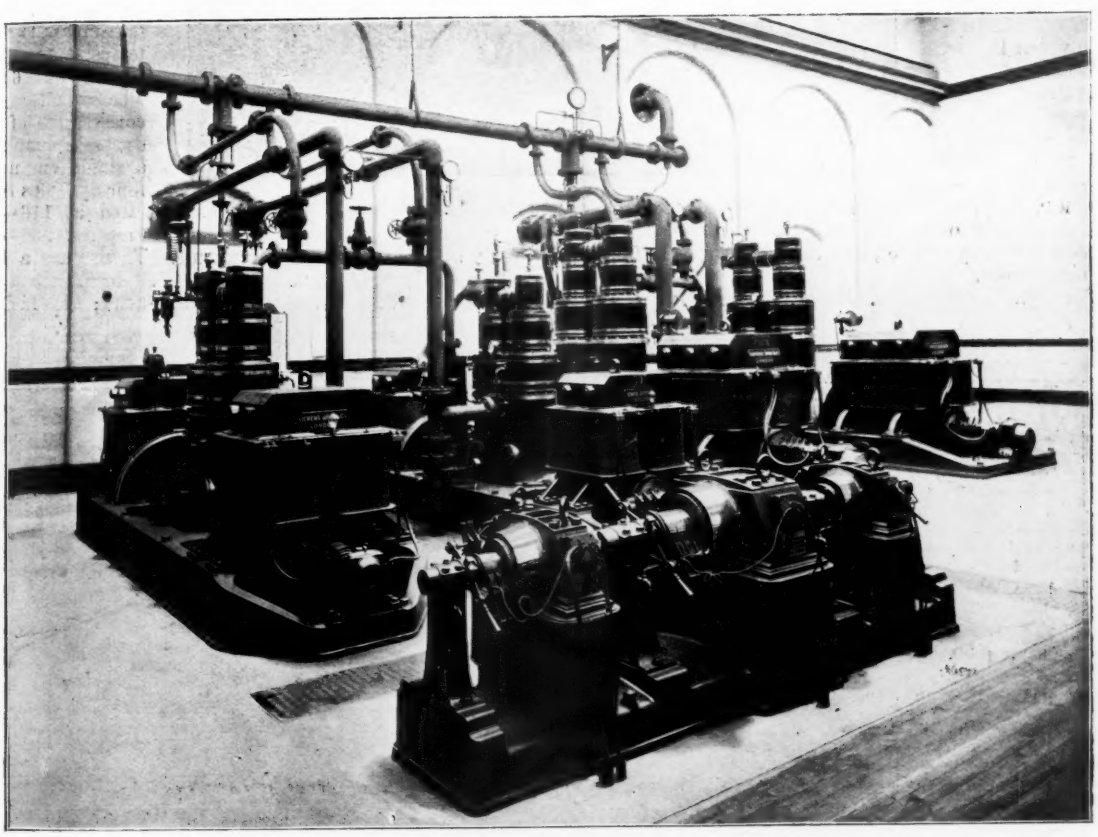
The scheme originally drawn up by Prof. Kennedy involved an expenditure of £30,000; the Local Government Board inquiry was held in December, 1897, by Col. Durnford, and the loan was sanctioned in due course. The scheme was put in hand without delay, and Mr. C. D. Burnet was appointed resident engineer.

In addition to the boiler and engine rooms, the buildings consist of general offices and waiting room, private offices for the engineer and his assistant, meter room, and drawing office, which may also be used as a test room.

The works have been erected close to the Citadel railway station, on a site where water for condensing can be obtained from the river, while coal is brought direct to the boiler house by means of a siding from the adjoining railway.

The floor of the boiler house is about 4 feet below the outside level, so that the coal is easily delivered from the trucks. At present there are three Lancashire boilers in position, made by the Oldham Boiler Works Company, Limited. These are 28 feet × 8 feet, working at a pressure of 160 lbs. per square inch, and are fitted with four cross tubes in each of the flues. The latter are 3 feet 3 inches in diameter at the furnaces, and the grates are 5 feet 6 inches long.

The boilers are fitted with the Union Iron Works Company's "Autostoker," with shifting firebars, which slowly convey the fuel from the firedoor to the back of the furnace, and drop the clinker through a space left for that purpose in the grate. Firing is, however, at present done by hand. A Green economiser of 192 tubes is provided; a clear space is left between this and the wall of the engine room, in which the condenser pipes from the latter are accommodated.



Generating Plant; Booster in Foreground.

The feed pumps are of the Worthington compound duplex type, and are rated at 1,400 gallons per hour each; but with the assistance of a head of water from the feed-water tank, they are capable of actually delivering 3,000 gallons per hour each. Feed water is obtained from the town mains, the river water being too muddy; the whole system is in duplicate, and the copper "bus" pipes, after passing the economiser, are separately connected with each boiler. The whole of the water is passed through a Kennedy water meter under pressure before entering the economiser.

Space is provided for two additional boilers, which will soon be installed.

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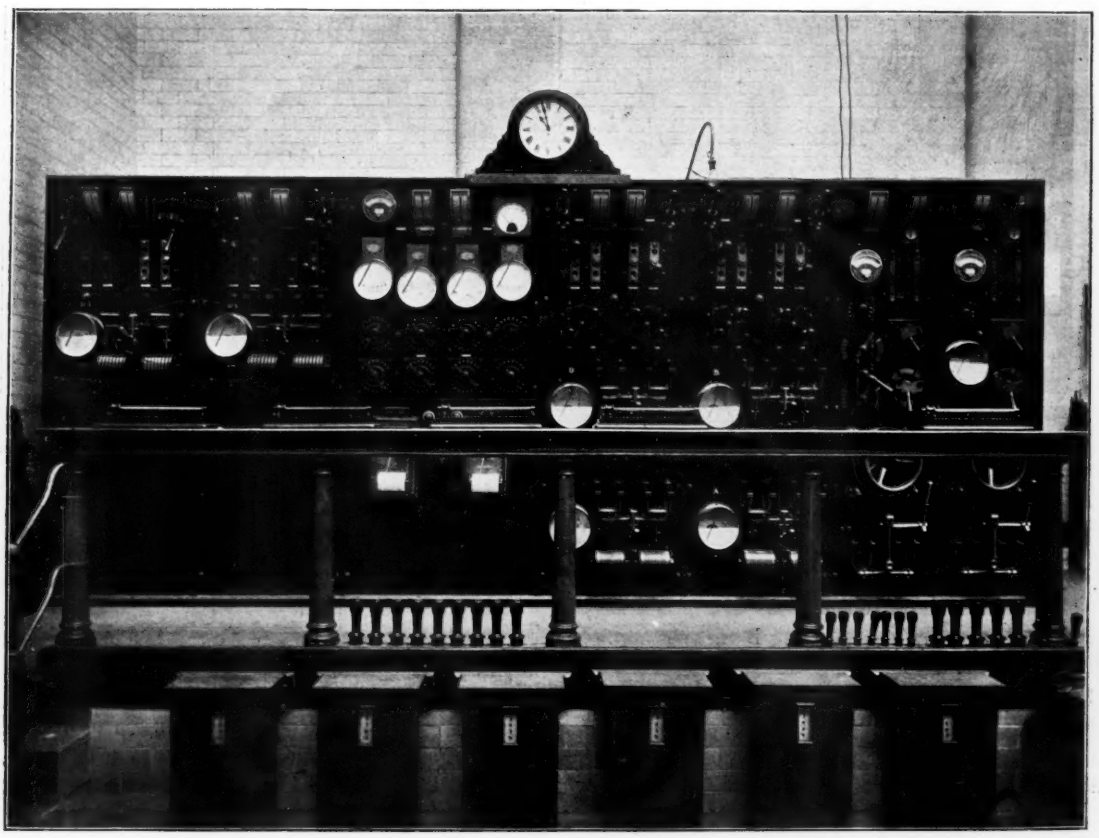
The steam pipes are of steel, with cast-iron tees and copper bends; there is a complete ring main, and two separators are placed in the course of the steam, close to the boilers. The pipes, 8 inches diameter, are made with screwed and brazed flanges, and the joints are packed with Taylor's corrugated rings. These are to be covered with "Washington" lagging, while "Leroy" lagging has been used for the boilers.

The chimney stack is 160 feet high, and about 7 feet diameter inside.

The engine room is lofty, and unusually well lighted from the roof. The plant already installed consists of two steam dynamos of 200 I.H.P. each and two coupled sets of 100 H.P. each, as well as a pair of boosters driven by a motor, seen in the foreground of one of our illustrations.

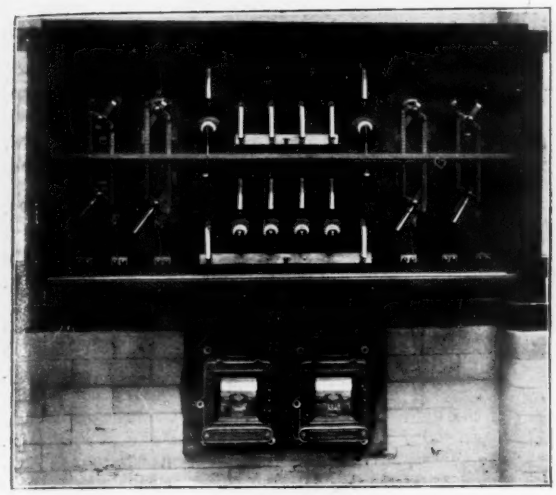
Lancashire Boilers.

The dynamos are all of Messrs. Siemens Bros.' manufacture coupled to Willans engines; the larger machines are provided with series over-compounding coils for tramway working, as the Corporation will supply power to the tramway company. These machines are rated at 255 amperes, 490 volts, at 330 revolutions per minute when running shunt, and 550 volts, 227 amperes, at 350 revolutions per minute, when compound; the increased pressure in the latter case being obtained partly by increased armature flux and partly by increased speed. The combined efficiency of one of these sets was 78·35 per cent. at $\frac{3}{4}$ load, with a consumption of 22·27 lbs. water per E.H.P.-hour at that output. The maximum rise of temperature above the air was 65° F. The smaller sets consist each of two dynamos coupled to a single engine, all four dynamos being rated at 116—131 amperes, 230—260 volts, at 460 revolutions per minute. These gave a combined efficiency of 78·35 per cent. at full load, with a consumption of 22·5 lbs. water per E.H.P.-hour; the efficiency at $\frac{3}{4}$ load was 73 per cent.; at $\frac{1}{2}$ load 66·3 per cent., and at $\frac{1}{4}$ load 51·73 per cent., with a maximum temperature rise



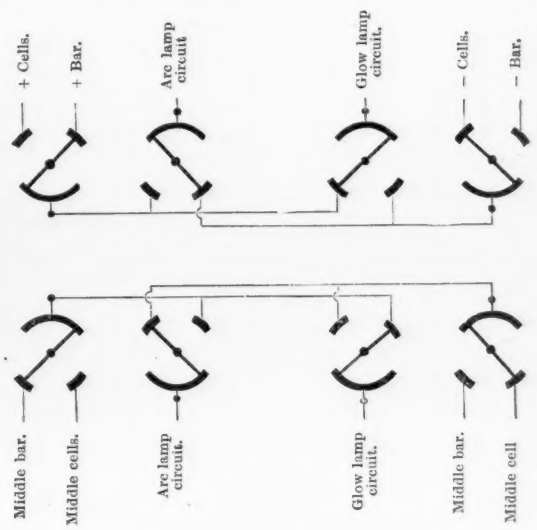
Main Switchboard.

of about 63° F. Two 400 I.H P. Willans engines, coupled to dynamos by Messrs. Bruce Peebles & Co., are on order; when these are erected, the whole of the space at present available will have been taken up. The booster set consists of a motor with speed variable from 500 to 1,050 revolutions per minute, coupled to two boosters taking 60 amperes each, with a maximum boost of 80 volts. This set was manufactured by the Electric Construction Company, Limited.

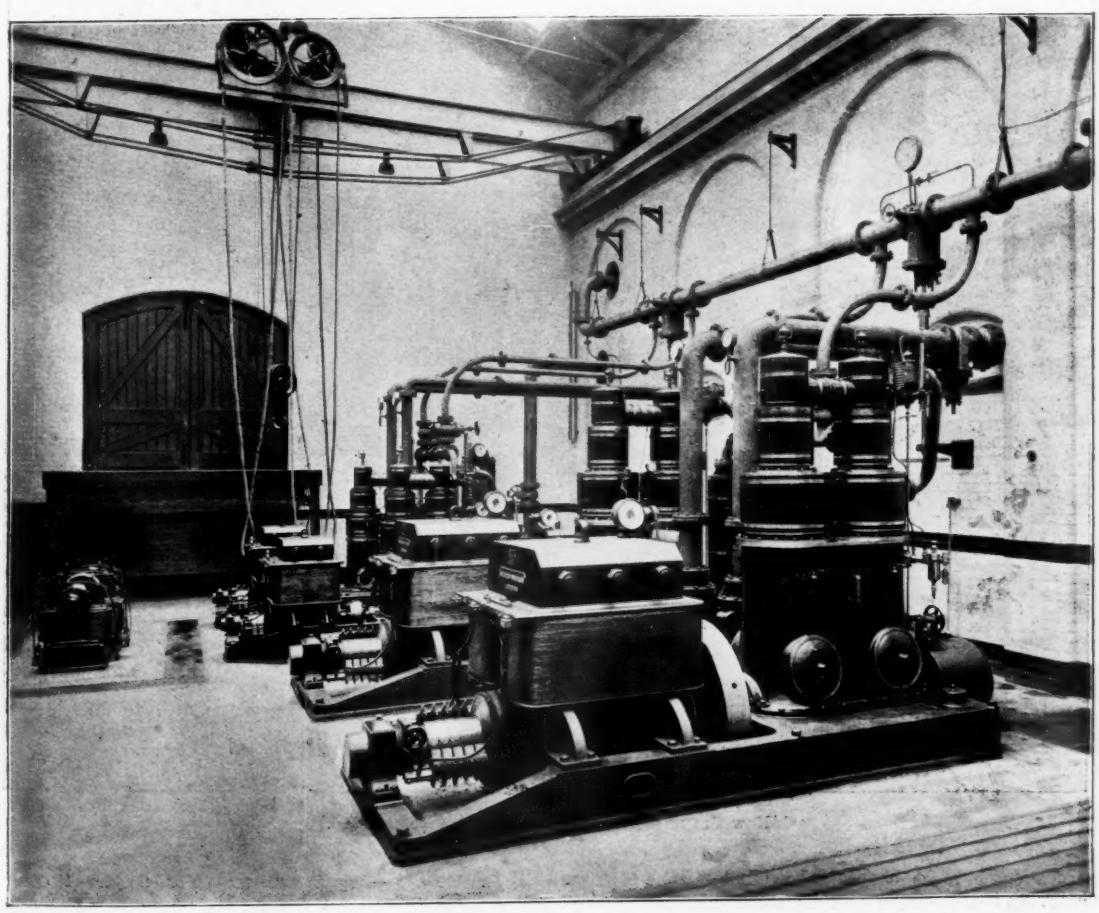


Works Lighting Switchboard, showing coupled two-way switches.

The steam pipes to the engines are so arranged that each is provided with a duplicate supply; the exhaust pipes are teed to a vertical pipe, which leads upwards to the condenser and downwards to the main exhaust pipe to the atmosphere. The latter path lies through a balanced automatic relief valve, which may be opened by hand, but is intended to provide an alternative outlet for the exhaust steam in the event of an accident to the condenser. The main exhaust pipe is 12 inches in diameter, and is led up to a height of 44 feet.

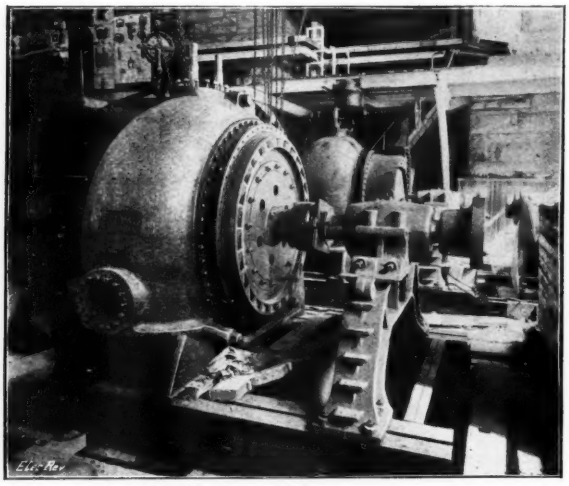


Station Lighting Switchboard.
Diagram of connections of coupled two-way switches.



Generating Plant.

The condenser pipe passes through the wall of the engine room and downwards to a Ledward ejector condenser, which is fed from a water tank 36 feet × 14 feet



New Plant for Niagara.—Fig. 2. (See page 563.)

× 8 feet deep on the roof of the boiler house. In addition to a sluice valve, an automatic non-return valve is fixed between the engine and condenser, to keep the water out of the engine in case of a mishap. Each of the larger condensers is capable of condensing 4,000 lbs. of steam per hour, while the smaller ones are rated at half that value. Condensing water is derived from a tank built in the river bed, whence the water is drawn by a centrifugal pump made by Messrs. Drysdale & Co., Glasgow. The pump is driven by a 25 H.P. Siemens motor, and is able to deliver 45,000 gallons per hour to the tank, with a total lift of about 46 feet. Some difficulty is experienced in dealing with the water, which is very muddy. It is no uncommon thing for fair-sized eels to be found in the water tank!

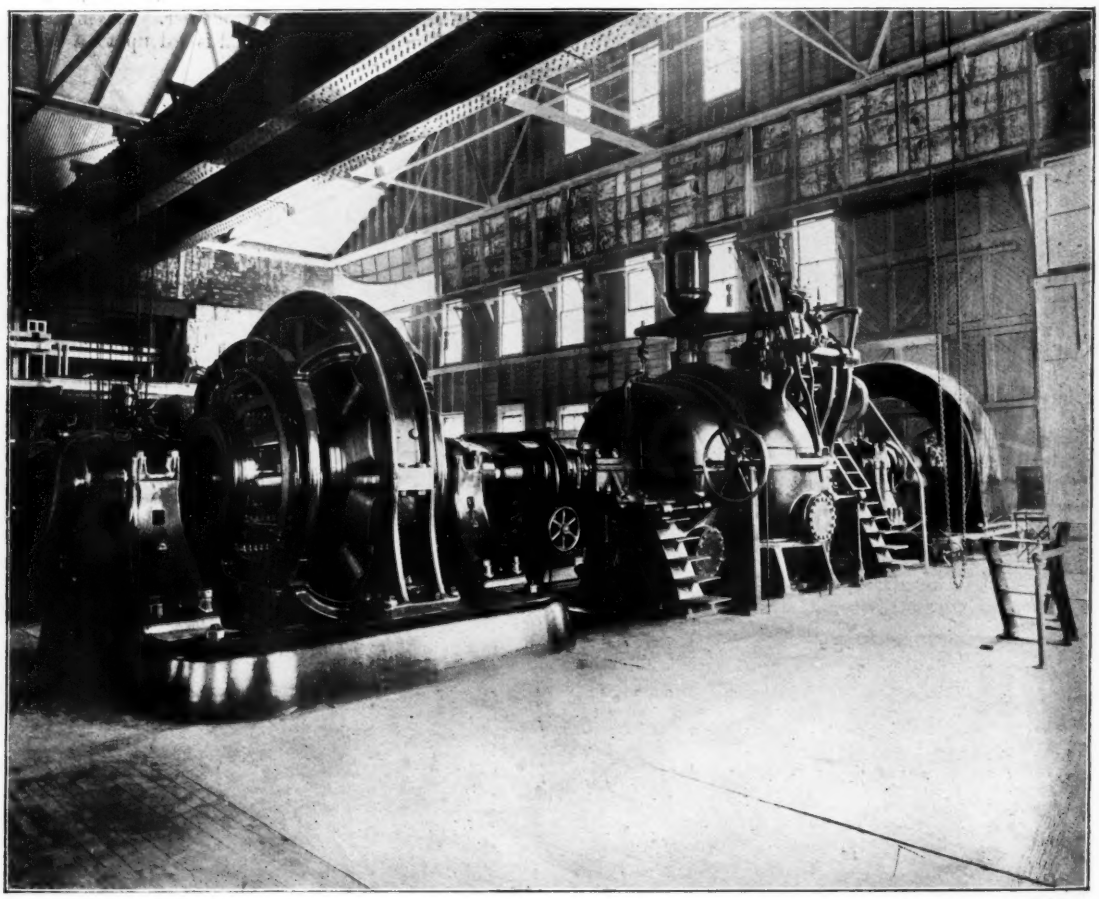
An overhead crane of light construction spans the engine room. This was made by Messrs. Carrick & Ritchie, and is capable of lifting a load of 10 tons.

The foundation of the works is borne on a gravel sub-soil. To minimise vibration a layer of concrete 18 inches thick was first put down all over, and the engine block, of concrete 26½ feet × 60 feet × 6 feet thick, was constructed upon this with sand centres at intervals. Passages are provided beneath the floor, in which the exhaust and other pipes are laid.

A battery of 250 Chloride cells is housed in a room adjoining the engine room. The normal capacity is 300 ampere-hours, with a maximum discharge rate of 120 amperes for half an hour. The plates are contained in glass boxes, which are arranged in two tiers.

The main switchboard, of which we give a photograph, is arranged for a three-wire distribution system, and was built and equipped by the Electric Construction Company, Limited. It is mounted on a platform commanding a clear view of the engine room, with ample space both behind and below. Most of the instruments are of the Kelvin type, made by White, of Glasgow; the exceptions are four Weston voltmeters and two Holden recording voltmeters. There are seven slate panels, arranged as follows:—

Panels 1 and 2—double-pole feeder switches, two 240-ampere gauges of the edgewise type, double-pole automatic cut-out, bus bars, and dynamo ampere gauge to 320 amperes.



New Plant for Niagara.—Fig. 1. (See page 563.)

Panel No. 3—edgewise ammeters on middle wire (150 amperes) and earth connection (10 amperes) with direction indicators, two 450—570 voltmeters, and two 200—300 voltmeters, eight voltmeter

switches with eight points each, and two Weston voltmeters for pilot wires from feeding points (190—270 volts).

Panels 4 and 5—d.p. feeder switch, two edgewise ampere gauges (240 volts), two ampere gauges (200 amperes), two d.p. automatic switches, bus bars, and middle-wire bus bars with safety shutters.

Panels 6 and 7—two edgewise 120 ampere gauges (one with direction indicator for battery), one Weston voltmeter (0—90 volts), shunt switch and reversing switch for booster, battery regulating switch (12 cells) and emergency switch, while one panel bears the booster motor starter, the other the motor ampere gauge (50 amperes).

The booster starting resistance is placed half on each pole, with the contacts slightly "out of phase;" as the positive and negative are coupled together, the effect is, of course, the same as if twice as many contacts were placed on one pole, but the arrangement is neater, and the travel far less than would then be the case.

The booster reversing switch is interlocked with the battery regulating switch in a singular manner; it is impossible to move the former except when the latter is in one of two equivalent positions, in which the whole of the cells are in circuit. The booster can then be switched on, and can be used either to charge the battery or to assist in the discharge; but as the battery is never disconnected from the mains, the voltage of the booster has to be varied according to the position of the regulating switch, and this is a source of great inconvenience, apart from the excessive pressure which may be applied to the mains when introducing the booster into or removing it from the circuit.

The automatic cut-outs are provided with a differential arrangement, by means of which a wide range of adjustment is obtained, with the important advantage that the circuit is broken if the current falls to zero, or if the current reverses in direction, but not if a short occurs on the mains. This is accomplished by the addition of a shunt coil to the usual series winding.

The battery is at present able to cope with the whole of the ordinary night load, which includes public lighting. A Miller reversible meter is to be used for checking the performance of the battery. Each machine also is in circuit with an Aron meter, including the motor which drives the boosters.

The public lighting is carried out by means of 25 10-ampere Crompton arc lamps, run 10 in series across the 460-volt mains, from dusk to daybreak. The lamp-posts are of a neat design, made by Messrs. McKenzie, Edinburgh.

Private supply is provided for with concentric mains, armoured and laid direct in the ground. The whole of this work was done by the Callender Company on their usual system.

The distributors are triple concentric, ·12, ·06, ·12 square inch; the feeders, of which there are three, are two-wire, ·25 square inch, the middle wire being connected with the works by two single cables of the same section.

The arc lamps are wired with 7/16 S.W.G. armoured cable. There are also a number of three-core pilot cables. All the feeder and pilot cables end in an underground chamber in the roadway near the works, whence they are carried as separate conductors through a subway to a chamber beneath the switchboard, and distributed to the back of the board. In this chamber are also the Siemens resistances for the generators and the E.C.C. resistances for the boosters and motor. The main fuses are mounted on the back of the switchboard, where there is ample space.

The supply to consumers is charged for on a sliding scale, as follows:—

For lighting, up to 1,000 units per annum	...	5d. per unit.
" 1,000 up 3,000 "	...	4½d. "
" over 3,000 "	...	4¼d. "
For power, up to 50,000 "	...	2d. "
" over 50,000 "	...	by agreement.

A number of Ferranti meters are in use, but the greater part are Chamberlain & Hookham's.

The supply to the tramway company was originally estimated at 400 H.P., but this will probably be exceeded. Energy supplied will be charged for at the rate of 2d. per unit for a minimum of 200,000 units per annum, with a sliding scale for higher consumptions. As these terms are no better than those offered to ordinary consumers of one-fourth the amount specified, we imagine that the price will be subject to modification.

The station was wired for electric lighting by the British Illuminating Company, Edinburgh. Mr. Burnet's experience of breakdowns at other works, and of repairs effected by the light of vestas and dips, has led him to devise a special switchboard, which we illustrate on page 561. The connections are made clear by the diagram, which shows that there are no less than *four* alternative ways of obtaining connection, either with the battery or the bus bars on either side of the system.

We have to express our thanks to Mr. Burnet, the city electrical engineer, and his assistant, Mr. G. G. Scurfield, for their kind assistance in the preparation of this description.

NEW PLANT AT NIAGARA.

We reproduce on the opposite page two photographs recently taken in the station of the Niagara Falls Hydraulic Power and Manufacturing Company at Niagara Falls. In fig. 1 is to be seen a new set of machines lately connected up. The generator in the foreground supplies the National Electrolytic Company with current of 5,000 amperes at 175 volts. Its capacity is about 875 KW. The turbine was made by Messrs. R. D. Wood & Co, Philadelphia, and is of about 2,500 H.P. This is the first turbine installed in the station by the company. The machine connected to the far side of the turbine is the dynamo recently portrayed in these columns while being lowered over the cliff. It is a dynamo which supplies current to the incandescent system of the Buffalo and Niagara Falls Electric Light and Power Company.

Fig. 2 shows two new turbines of Messrs. Wood's make in course of installation. The turbine in the foreground gives an excellent idea of the construction of these power producers; others of the same class and type will be installed in the immediate future. Each of the turbines is of 2,500 H.P. capacity, and will be operated under a head of 210 feet. Their location will be over valves on the same penstock as shown in fig. 1, but they stand to the rear of this turbine. Each turbine is fed through a 60-inch valve.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 558.)

Chester.—A special meeting of the General Purposes Committee was held last week to consider whether it would be advisable for the Council to take over the present tramway system at the expiration of the present term, which terminates shortly; 13 members were in favour, and 13 against the proposition. Further consideration was adjourned until next Council meeting.

Derby.—The Electric Light Committee has decided to fix the charge for power as follows:—3d. per unit for the first 12 hours per week, 2d. per unit for the next 18 hours per week, and 1d. per unit for all quantities after.

Dublin.—On 28th ult. Mr. A. P. Trotter, Board of Trade inspector, opened an inquiry at the Four Courts into four accidents that occurred to the electric trams recently. The following report is from the *Irish Daily Independent*:—Messrs. J. Gordon, Q.C., and J. Fitzgerald Murphy (instructed by Messrs. Casey & Clay), represented the Tramway Company. Mr. Bonass, law agent to the Corporation, Mr. H. Campbell, town clerk, and Mr. S. Harty, borough surveyor, attended on behalf of the Corporation.

The accident of June 20th, when a standard was broken in Grafton Street, was first investigated.

Mr. J. W. Towle, electrical engineer to the Tramway Company, explained that the accident was caused by the trolley head catching in the wire and breaking the cast-iron base of the standard. The trolley head then in use was one of the oldest style they had. The company were replacing these trolley heads by others of a new design, that were so constructed that they would, as far as it was possible to do it, get rid of the projections that seemed to cause the accidents. A chain was used to prevent the trolley head from falling.

The Inspector considered the accident was a very obvious one.

Mr. Trotter next dealt with the accident that occurred at Talbot Street on July 30th, and which was caused by a passenger pulling the trolley rope in mistake for the bell rope. He (Mr. Trotter) had the evidence given at the police court before him, and he considered the matter was very clear.

Mr. Gordon pointed out that the bridge was very low at the point where the accident occurred, and at first the Corporation and the tramway company were not quite at one as to the best method of putting up the wires there. A change had now been made that would practically prevent the occurrence of accidents at the place in future—the span wires had now been done away with. The accident

was really one of those which the company could hardly avoid. It was almost impossible to prevent a passenger from doing occasionally something that was wrong, not thinking, of course, that it was wrong. What actually caused the alarm and electrical flashes was that after the trolley head had come off, and one of the span wires had been broken, a second car coming from the opposite direction, tried to go through. The result was to intensify the accident which had already occurred. When the servants of the company became better acquainted with the working of the system these dangers would be eliminated. Some of the passengers were injured and taken to hospital, but had long ago been discharged. The injuries were not serious, and any claims made had been settled by the company. Counsel pointed out that the company were obliged to put up guard wires to prevent any injury being caused by telephone wires dropping on the electric wires. He was instructed that within a very short period a very large proportion of the telephone wires would be put underground, and to that extent the guard wires could be abolished. Mr. Parshall, who was an expert, considered it would be better to have the guard wires, where they existed, insulated, and then if they came in contact with the current, there would be no explosions. That would prevent the destruction of the wires, and also prevent people from being alarmed.

The Inspector: That is a very technical matter. I should like to discuss it with Mr. Parshall, and convince him of another view. I have the police reports and the newspaper cuttings here, and I see nothing there about the second car.

Mr. Gordon: It was the second car that really caused the flashes. The company are most anxious that everybody should know what exactly occurred. The company are now in a position to get rid of all the causes, as far as it is possible to get rid of them.

Dr. Chance, in reply to the Inspector, stated that about September 1st he examined the persons who were injured. They suffered mostly from mental shock. He believed there were some slight burns, but they were healed when he made the examination.

To Mr. Gordon: One of the men was a car driver, who was not in the tram at all. He drove the injured persons to the hospital, and went back and picked up another fare.

And afterwards got an electric shock?—Yes.

Mr. H. F. Parshall, electrical engineer, stated it was the first time in his experience that a passenger had mistaken the trolley rope for a bell rope. He believed the trolley could be so constructed as to prevent accidents in such a case. At present the trolleys were liable to jump the wire on various occasions. There should be stops on these trolleys, and already they were proceeding to put up these stops. Dealing with the slackness of the ropes, he thought it might be remedied by running them through a ring at the head of the standard, and then bringing them down by the side of the car. He should prefer that the conductors did not keep the trolley rope in hand coming round corners.

The Inspector said he was in favour of the abolition of guard wires altogether.

Mr. Bonass said Mr. Harty was anxious on behalf of the Corporation to give any information required, and also to make some observations about speed.

Mr. Gordon: I think the question of speed does not arise.

Mr. Harty: I think the question of speed does arise. I have returns here from the police, and the number of accidents really is astonishing—collisions with both cabs, cars, and people.

Mr. Gordon submitted that the matter of speed did not come within the inquiry. The company were carrying out the conditions laid down at the last inquiry with regard to speed.

The Inspector ruled that the question of speed was outside the scope of the inquiry.

Mr. Harty: We think the speed limits are vastly exceeded, and that there should be speed indicators on the cars.

Mr. Gordon: We don't admit that. We think we are keeping within the limits of the order.

Accidents of July 31st and August 6th were then dealt with. Mr. Towle stated that the former one, which occurred at the junction of Gardiner Street and Talbot Street, was caused by the trolley coming off the diagonal crossing wire, coming in contact with the guard wire, and pulling it against the trolley wire. The other accident occurred in College Green. The new trolley had got caught in the frog, and was pulled off. The trolley wheel was very deeply worn. It was after that accident the chain was introduced, and he believed that would prevent such accidents in future.

To Mr. Gordon: Stops are being put on now to prevent the trolley wire getting too high. I have endeavoured to arrange the stops so that the trolley would not reach the guard wire, but that would be a very difficult adjustment.

This concluded the inquiry.

At Dublin last week the case of the Pembroke Urban District Council *v.* the Dublin Southern District Tramway Company was listed on an application by the plaintiffs for an injunction to restrain the defendants from breaking up certain of the roadways in the Pembroke township for the purposes of their electric tramway contrary to the wishes of the road authority and to an agreement of May 20th, 1896, entered into between the parties. It was alleged that the defendant company had, for the purpose of laying down new conduit pipes for electric cables, improperly broken up the macadamised portion of the road between Merrion and Ballsbridge, instead of laying them down underneath the paved tram tracks. The tramway company contended that they were entitled to lay the new cables outside the tram tracks. Mr. Justice Kenny granted an adjournment for a week on the undertaking that the work complained of would not be proceeded with.

After the inquiry was closed, Mr. A. P. Trotter, inspector to the Board of Trade, inspected the most recently equipped lines of the Dublin United Tramways Company. Mr. Trotter, who was accompanied by the engineers and other principal officials of the company, expressed his complete satisfaction with the manner in which all the works connected with the establishment of the electrical service in the districts included in the latest development of the company's system have been carried out. Mr. Trotter also visited the new power station at Ringsend.

Holywell.—At a meeting held to consider the need for improved railway facilities, Mr. L. Barnes (of Sloan & Barnes, electrical engineers, Liverpool) attended to explain a proposed scheme for an electric railway from Holywell through Bagillt and Flint to Shotton, in order to get into communication with the Great Central Railway. Nothing was decided *re* same.

Huddersfield.—A section of the extension to the tramways was completed last week. The track (Crossland Moor Bottom to Pinfold Well) has been prepared for electric traction, although in the meantime steam cars are running over it.

Keighley.—The Town Council last week accepted the following recommendations submitted by the Gas Committee:—That the electricity works be built on the Low Bridge site; that an interview be arranged between the Electricity Committee and the Tramway Company's directors; and that the object of such interview be the purchase of the Tramway Company's undertaking.

Kingston.—The Town Council has resolved to apply to the Board of Trade for a provisional order for the construction and working of tramways in the borough.

Light Railways.—The Duke of Devonshire, on Tuesday, cut the first sod of a light railway which is to be constructed, under the provisions of the Light Railways Act, in North Staffordshire, by the North Staffordshire Railway Company. The line is not an electrical one, but the statements made by the Duke in proposing the toast of "The Leek, Caldon, Low, and Hartington Light Railways," are of interest to all who are in any way identified with the light railway development, for which there is such great scope in this country. He said that, compared with other railway undertakings, this was not a very big one, but nevertheless it was of very considerable interest to that district, and he hoped it would prove of very substantial advantage to it. There was every prospect of the work being shortly put in hand and brought to a speedy and successful completion. If they compared the conditions under which the small sum yet to be raised was asked for, with those under which appeals to the speculative public were generally made for railway enterprise, he could only express his astonishment that all the capitalists of London, Birmingham, and other large towns were not tumbling over each other to obtain this investment. He could only suppose that it was because it was so very small that they did not think it worth their attention. He had been looking at some railway statistics the other day, and as far as he could make out, railways in the United Kingdom had cost about £50,000 per mile to construct, and notwithstanding this enormous expenditure, they were, he was happy to say, earning a return of over 3½ per cent. on that expenditure. In this case they would have nearly 10 miles of railway for £35,000, or between £3,500 and £4,000 a mile. Nearly 30 per cent. of the capital had been presented to them by the Government. According to the statistics to which he had already referred, the railways in the United Kingdom were now earning £4,000 a mile, but in this modest undertaking they would be quite satisfied if they could earn £5 a week, or £260 a mile per annum, for a return to that extent would give the shareholders 5 per cent. for their money. He knew it was very idle to compare such vast things as the great railway system of the United Kingdom with their little undertaking; but, without going into comparisons such as those he had entered into, he believed the estimates of expenditure and traffic receipts would show the desired return. They were only founded upon the resources of the district as they at present existed, but he need hardly say that, in this case, and in a great many others, it was quite possible that the construction of a light railway would develop in the district resources at present dormant and unknown. They knew that in former times very valuable mines had been worked in close proximity to this line of railway, and he believed that it was not at all impossible that, with improved access to them, mining enterprise might again be opened in the district. At all events, it was quite certain that this line would give access to a most beautiful and picturesque district, and they all knew how great a source of profit to railways in recent years had been the tourist traffic which had been developed. He could not help thinking, therefore, that this line had a very good prospect before it.

Leeds.—A resolution was submitted to the City Council on Wednesday, authorising the Tramways Committee to take steps to equip on the overhead electric system the following tramways:—Vicar Lane, Beeston Hill, Elland Road, Whitehall Road, Wortley, Armley and Stanningley, Woodhouse Street and Victoria Road, Meanwood, Park Lane, Burley Street, and Cardigan Road, and Hunslet Carr.

A deputation from the Leeds Tramways Committee inspected the Springburn electric tram system, Glasgow, last week.

Lincoln.—The City Council, meeting in committee, has resolved to apply to Parliament for power to carry out one of the three schemes before it for providing electric tramways. The adopted scheme will give a line from the Burton Road to St. Mary's Square. A second line will begin near the race-course, and run eastward to the Arboretum.

Liverpool.—At Wednesday's Council meeting the Tramways Committee advised that application be made for a provisional order giving them the power to affix to any house or building brackets, electric conductors, wires, and apparatus, provided com-

pensation is paid for any injury sustained. The Committee was also to ask for a supplementary grant of £65,000, and the approval of the tender of Messrs. Dick, Kerr & Co., of London, for the supply of 200 cars at £525 per car.

Last week an electric tramcar collided with a trap and threw out the occupant; another car collided with a lorry laden with flour, with serious results to both the car and the driver. Another day a car collided with a bus and threw the horses down. There must be something wrong somewhere, if the facts are as recorded.

A would-be suicide threw himself in front of an electric car in Park Road last week. The lifeguard was promptly brought into play, and the man was lifted out of harm's way practically uninjured. The brake was also promptly applied, and the man was taken from the guard three yards from the spot where he fell.

Llanelly.—It was reported at the meeting of the borough Council on Monday that the estate committee had two excellent schemes before them for lighting the town by electricity and laying down a system of electric cars, to take in the surrounding villages of Llwynhendy, Pwll and Felinfoel. The committee were expecting a third scheme in a few days, and they proposed to call in an expert to advise them as to the best of these.

London.—The Wandsworth Board of Works, which is, as a rule, not at all favourably disposed towards the London County Council in regard to tramway matters, has decided not to raise any objection to an application by the Council to the Board of Trade for a license permitting the experimental use of mechanical traction on the line between Westminster Bridge and Tooting.

Manchester.—The Tramway Committee recommends the Council to obtain borrowing powers for the electric tramway scheme as follows:—

£250,000 for the reconstruction of the permanent way,
£150,000 for the overhead equipment,
£360,000 for the purchase of 600 cars,
£90,000 for certain lands and the erection of a car shed in Queen's Road, and
£10,000 for other preliminary expenses.

The total amount required to date is £860,000, and this is but an instalment of the committee's ultimate requirements. At the next meeting of the City Council an important report will be presented by the Tramways Committee in the name of the Routes and Permanent Way Sub-committee. The report says that the advice of Mr. J. Kincaid confirmed the opinion of their own engineer that the whole of the permanent way required reconstructing. It recommends *inter alia* the borrowing of a quarter of a million sterling for that purpose, and advises that work be immediately commenced by the Corporation's own workmen reconstructing the Cheetham Hill lines, the Rochdale Road lines, and the Bury New Road lines, and constructing new lines in Queen's Road, giving access to the car shed. In regard to overhead equipment, the committee advised the use of poles on each side of the road with short arms (having bowstring suspension for the trolley wires), necessitating the adoption of the side-running trolley, as seen by them at Liverpool; in the streets which are too wide for this form of construction centre poles with bowstring suspension are advised, and Mr. Wordingham, the city electrical engineer, concurs. The committee is preparing plans and sections of a large number of proposed extension lines, with a view to Parliamentary powers being obtained during the next session. The new lines aggregate about 22 miles.

The Mersey Railway and Electricity.—The chairman (Mr. J. Falconer) of the Mersey Railway Company addressed his shareholders as follows last week *re* electric traction:—

"At the last half-yearly meeting it was explained that the board proposed to take the best advice they could obtain with reference to the traction which should be employed on the railway. The subject had been repeatedly under the consideration of the directors and of the receivers and managers; and they had had the assistance of electrical engineers. The board had hoped that they might have been enabled to present at that meeting an authoritative report on this question; but the working of such an undertaking as theirs by electricity was novel, and the step would be attended with such important consequences to them that he was sure the shareholders would recognise the necessity of the fullest consideration being given to the matter before any scheme was adopted. The directors had been impatiently pressing for progress on the part of their electrical engineers, but he could not say that those gentlemen had shown any undue delay, looking at the importance of the subject. The electrical engineers whose advice the directors proposed to take finally were Sir William Preece and Major Cardew, who had promised to submit their report soon. As soon as possible after receiving it the directors would present to the shareholders their recommendations on the whole matter.

Oldham.—Last Thursday week the Surveyors and Tramways Committee had an important question before it in regard to the tram rail contract. It seems that an agreement had been entered into with a Barrow firm whereby the latter undertook to supply the Corporation with 25 miles of steel rails. The Corporation wanted rails for 25 miles of track, and understood the contract in that way. The company now contend that they only undertook to supply 25 miles of rail, or 12½ miles of track, at the price named. The price of steel, it seems, has gone up considerably since the contract was made, which means that the Corporation would have to pay considerably more if the contract, as they understood it, was not carried out. Some discussion followed but no decision was come to.

Paisley.—The proposals of Glasgow for taking over the working of the Paisley tramways not having come to fruition, the whole question, so far as Paisley is concerned, is still in solution, and the Council now have three alternative schemes for the improvement of their system. A Glasgow paper says that Glasgow's offer still holds, the course for municipalisation is open, and overtures of a practical nature have again been put forward on behalf of the British Electric Traction Company, Limited, whose previous offer was finally rejected at an inquiry by the Light Railways Commission a year ago. At the last monthly meeting of Paisley Town Council it was agreed that they were not in a position to reply definitely to the offer of Glasgow Corporation to hold to the agreement entered into between them last year, and a proposal to municipalise was rejected as being premature. It is anticipated that the whole question will be submitted to the ratepayers at the November elections.

Nottingham.—At Monday's meeting of the City Council the report recommending the overhead trolley for the tramway system was adopted. The course which matters have taken was explained by Alderman Brownsword, who proposed the adoption of the report in the following terms:—

Now he came to the joint report of the Committee, recommending the Council to authorise the starting of the laying down of the system of electric traction. The Council had already come to the conclusion that electric traction should be used, but there was some little doubt as to whether it should be the overhead or the conduit system. The Committee had two or three very pleasant little jaunts to several places to look at the kind of traction used there, and Mr. Brown and Mr. Talbot, the electrical engineers, had paid a visit to the United States of America to inspect the systems used there. Their report was presented to the Council at the last meeting, but he did not think the report received the amount of attention it should have done. Those two gentlemen and the Committee had come to the conclusion that overhead electric traction was the most suitable for the city of Nottingham. The underground system would do harm to the sewer pipes; and it was also not thought advisable to lay it down because of the bridges. There were other difficulties in the way of the underground system which it was felt did not apply to the overhead system, and, taking all the circumstances into consideration, the Committee unanimously agreed to recommend the Council to commence the overhead system of traction. The difference between the cost of electric traction and horse traction would at least double the net receipts from the undertaking—that was to say, where it cost 10d. per mile now to run the horse cars, the probability was that 6d. per mile would be the outside cost of the overhead electric traction system. If the present system, therefore, produced a profit of £12,350, the electric would produce £24,000. All the money would be wanted, however, to pay the sinking fund and relievable profit, but when the electric scheme was instituted they would carry a greatly increased number of passengers.

St. Helens.—The Electric Supply and Tramways Committee has decided to include in the proposed application for a provisional order the following additional tramways: Along Eccleston Street and Knowsley Road, from Lawrenson Street to Dunriding Lane; and from Westfield across Ormskirk Street to Cotham Street.

Seville.—The *Financial Times* says that the first main section of the electric tramways at Seville, which are the property of the Seville Tramways Company, Limited, has now been opened to traffic. The conversion of the tramways to the electric system, and the extension of the lines, have been carried out by the General Electricity Company, of Berlin, which constructed the electric lighting station at Seville, from which the current for the working of the tramways is supplied. It is stated that although owned by the Seville Tramways Company, the undertaking has been financed by the General Electricity Company and the Zürich Bank for Electrical Enterprises.

Sheffield.—An electric car on the Walkley section collided with a two-horse carriage on 28th ult. Both were slightly damaged. The Pittsmoor section of the municipal electric tram system was opened last week. The first car ran for public service on 27th ult. The Board of Trade inspector, Mr. Trotter, went over the line the previous day and passed it.

South Shields.—A public meeting has been held in support of a movement for the Corporation taking over the working of the tramway system.

Southampton.—The Tramways Committee will not include any of the extension works outside the borough in its application for a provisional order, but will defer these matters for the present. The town clerk is to confer with the electrical engineer for arranging the necessary plans, &c., for deposit with the Board of Trade in connection with the order.

Spen Valley.—On Monday the Liversedge District Council considered the correspondence which had passed between the clerk and the solicitor to the British Electric Traction Company with reference to a suggestion that the company were not bound to construct the local branch lines promised to the Council during the negotiations preceding the inquiry at Dewsbury, and referred to in an agreement between the Council and the company. The company's solicitor said that the necessary steps were being taken for the promotion of the lines mentioned. His clients were not promoters in the ordinary sense, but investors seeking suitable outlets for their capital, and, therefore, they only promoted lines with the intention of constructing and working them at the earliest possible opportunity. The probability was, moreover, that the company would carry out a much larger scheme than that passed by the Commissioners and referred to in the agreement.

Staffordshire.—A Wolverhampton paper says that under an arrangement arrived at between the South Staffordshire and British Electric Traction Companies, Tipton, Wednesbury, and West Bromwich will soon be linked to Dudley in the system of electric tramways that are so revolutionising the Dudley district.

Tipton.—The Urban District Council Tramway Committee last week reported that representatives of the South Staffordshire Tramway Company and of the British Electric Traction Company had waited upon the committee in reference to the tramways question. It was then stated that an arrangement had been come to for the formation of a new company, three of the directors of which would be from the South Staffordshire Company and three from the British Electric Traction Company. If the Council did not avail themselves of this opportunity of purchasing the lines three years hence, the company proposed to enter upon a

lease of 21 years' duration from 1902. Electric traction on the overhead system would be adopted. The proposals should be considered by a committee of the whole Council.

Traffic Regulations.—The bye-laws and regulations made by the Oldham, Ashton and Hyde Electric Tramways, Limited, are printed in the *London Gazette* for September 29th.

Warrington.—The Warrington Corporation has received an application from the Ormskirk and Southport Electric Light Railway Company, asking for the support of the Corporation in their application to the Light Railway Commissioners to construct light railways outside the borough and tramways inside the borough. The General Purposes Committee report that while the Committee are willing to give support to the construction of a light railway from the borough to Lymm and Knutsford, they cannot recommend the Council to entertain the proposal of the company to construct tramways within the borough.

Wigan.—The Tramway Committee will not entertain the purchase of the Wigan tramways at the price named by the tramway company. They recommend that application be made for a provisional order authorising the Corporation to construct certain additional tramways. The engineer was instructed to prepare plans for the proposed tramways to Maitland Mill Bridge. The electrical engineer was also instructed to prepare estimates for the electrical equipment of the line.

TELEGRAPH AND TELEPHONE NOTES.

The Amazon Cable.—The *Electrical World* says that the Amazon Telegraph Company, Limited, is stated to have decided to abandon the cable in the Amazon River from Para to Manaos. They are, however, building a landline with some links of cable, and have issued bonds for $600,000 at 5 per cent. A subsidy of $85,625 a year for 12 years was granted to the company by the Brazilian Government.

The American Cableship "Hooker."—The New York *Electrical Review* says that the United States War Department has learned that the United States cableship *Hooker* (described in this journal on May 12th, 1899), which recently ran aground on Corregidor Island, in Manila Bay, and was considered a total loss, may be saved. She had material for a submarine cable on board, and it was intended to use her in connecting all the important islands of the Philippine group by telegraph. General Otis reports that arrangements have been made for getting the *Hooker* off the rocks and taking her to Cavité arsenal, where she will receive repairs sufficient to permit her to go to Hong Kong to be thoroughly overhauled and put in first-class condition.

The Pacific Cable.—The *Times* correspondent at Ottawa says that the Earl of Aberdeen and Lord Strathcona have been invited to act as representatives of Canada on the Board of Control of the Pacific Cable. Sir S. Fleming in a letter to the Press on cable matters, advocates the acceptance by Australia of the offer of the Eastern Extension Company to lay a cable from Cape Colony to Australia, but with the condition that the Australasian Colonies may purchase the line at a fair valuation when they so desire.

Railway Telegraph Clerks.—A meeting of the Railway Telegraph Clerks' Association was held at Chester on Saturday, to protest against the action of the London and North-Western Railway directorate in declining to entertain the memorial presented last June, asking for an increase of salary and a few minor concessions, all of which had been refused. It is stated that in the service of the London and North-Western Railway there are 104 telegraphists with over 15 years' service, 52 with over 20 years, and 21 with over 25 years respectively, and the maximum salary (£80) is identical in each case.

Telegraph Congress.—The first annual congress of postal and telegraph officials opened at Derby last week. There were present 134 delegates from all parts of the United Kingdom, representing the various sectional associations connected with the service.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...

Telephone Conduits in Bermondsey.—The General Purposes Committee informed the Vestry at the meeting on Monday that the Postmaster-General desired to take up certain carriageways and footpaths in the parish for the purpose of laying conduits with multiple ducts or cast-iron pipes, and to construct manholes at intervals of about 150 yards. It was unanimously decided to give permission for the work to be carried out.

The Telephone Service.—We are authorised to announce that the board of the National Telephone Company has come to a decision respecting rates for telephone exchange service, elsewhere than in London, which will be received with widespread interest. It has been charged against the company that its present rates are prohibitive to people in a small way of business, who need to be on the system for the purpose of being accessible to their customers and others, but who do not otherwise require to make a large use of the service. The system which the company has hitherto adopted of charging all alike, whether they make great or small use of the service, does undoubtedly place the small user at a disadvantage. The Select Committee of the House of Commons which sat on the telephone question in the session of 1898, reported that whilst the company's present charges are reasonable in amount for those who make a large use of the service, they are unduly high for small users, and have, as a consequence, operated to retard the development of the telephone in this country. The Committee also expressed the view that the rates ought to be based upon the amount of use which each subscriber makes of the service. The directors of the National Telephone Company now propose that any subscriber shall have the option of taking at the existing rates an unlimited service—that is to say, a service without limitation as to the number of calls which he may make—or of paying an annual sum of £3 10s. (that is, £3 3s., the company's installation charge, and 7s. Government duty), which will confer the right of being called up, and the sum of 1d. each time he initiates a conversation. This fee of 1d. per call, which also includes the Government duty of 10 per cent., will give the subscriber the right to converse with all other subscribers on the same exchange as himself, or on such number of exchanges as may be grouped together to meet the requirements of local circumstances. It is also proposed to issue call office signs freely to shopkeepers and others who may join the system on the new terms, and it is anticipated that many will take advantage of the arrangement, as it will tend to attract customers. The opening of a large number of call offices from which messages can be sent for a small fee, should prove of material benefit to the general public. We understand that the proposed rates will be brought into operation on and from January 1st next, and that in the meantime full particulars will be advertised in the local press throughout the country. In view of the fact that the Government has decided to set up, by the Post Office, a telephone system in London, in competition with that of the company, the directors of the company are unable at present to deal with the question of the London rates.

The St. Luke's Vestry on Tuesday, on a second application from the Postmaster-General, decided to grant permission for the laying of telephone mains in certain roads in the parish.

Wireless Telegraphy.—The *Scientific American* says that "the *New York Herald* has made arrangements for the exclusive use of the Marconi system of wireless telegraphy for reporting America's cup races off Sandy Hook. Signor Marconi and four assistants have sailed from Liverpool with all the necessary instruments for use in reporting the races, and the work will be done under the personal supervision of Marconi and his assistants. The instruments will be placed on the *Grande Duchesse*, of the Plant line, upon the upper deck of which a tall pole, extending 60 feet in the air above the water line, will be placed, and a running account of the races will be telegraphed by Marconi and his assistants. On board the cable ship anchored near Scotland light a similar pole will be erected, and here two expert operators will be stationed to receive the message after it has been transmitted from the *Grande Duchesse*. From the cable ship the message will be transmitted by means of submarine and land wires. The steamer *Ponce* will also be equipped with wireless telegraphy apparatus, the system of Mr. W. J. Clarke being used. Rear-Admiral Bradford, chief of the Bureau of Equipment of the Navy Department, has been informed that Signor Marconi will go to Washington to discuss with him the proposed experiments with wireless telegraphy. Admiral Bradford will recommend that one of the vessels of the navy be set aside for experimental work. It is proposed to place the receiver on shore, and the warship will communicate with it from varying distances. By this means it is believed the system will be developed and the value of it will be definitely determined. It is stated that Signor Marconi has been approached with a view to experiments being made in wireless telegraphy between Canada and Newfoundland, and also between Nova Scotia and Cable Island."

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" this week.

France.—October 10th.—Tenders are being invited by the French Post and Telegraph Authorities, in Paris, for a quantity of telephone cable, and also of telephone insulated wire. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

France.—October 19th. The French Post and Telegraph Authorities in Paris are inviting tenders until the 19th inst. for the supply of 600 tons of copper wire in 12 lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et Telegraphes, 103, Rue de Grenelle, Paris.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 E.H.P. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Germany.—October 21st. Tenders are being invited until the 21st inst. by the municipal authorities for the supply of a 1,000-H.P. steam engine and multiphase dynamo at the local central station. Tenders are to be sent to Die Städtisches Electricitäts-Werke, 29, Silberstrasse, Dortmund, whence particulars may be obtained for 2s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Glasgow.—October 10th. The Corporation wants tenders for the reconstruction of tramways according to specification. See "Official Notices" September 23rd.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" this week.

Huddersfield.—October 13th. The Corporation is now advertising for tenders for the erection of tramway generating station, car shed, &c., at Longroyd Bridge.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" this week.

Leeds.—October 11th. Tenders are required for the installation of electric light and electric bells, at the Cookridge Street Baths. Particulars may be obtained at the office of Messrs Walter Hanstock & Son, Britannia Buildings, Oxford Place, Leeds. Tenders to be delivered at the office of Mr. W. J. Jeeves. Town Clerk.

Leeds.—October 11th. The Board of Guardians is inviting tenders for the supplying and fixing of a system of telephones and alarm bells at the workhouse, Beckett Street, Leeds. Specifications and plans have been prepared by Messrs. Shepherd & Watney, consulting engineers, Greek Street Chambers, Greek Street, Leeds, (copies may be had on payment of £1 1s., returnable on the usual conditions). Tenders to be delivered to Mr. James H. Ford, Clerk, Poor Law Offices, East Parade, Leeds.

Leeds.—October 18th. The Council wants tenders for 50 electric tramcars. See "Official Notices" September 23rd.

Leeds.—The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Peterborough.—October 19th. Tenders for the erection of electric generating station for the Corporation are now being invited.

Poplar.—The Guardians want tenders for Lancashire boilers, water-pressure drums and tanks, steam jet plant (ejector condensers, injectors, and jet pumps), also auxiliary pumping plant. The work is divided into several sections and copies of the conditions, &c., for each may be obtained from the consulting engineer to the Guardians, Mr. F. J. Warden-Stevens.

Rotherham.—October 9th. The Corporation is wanting tenders for Lancashire boilers, engines, dynamos, pumps, condensing plant, crane, economiser, battery, switchboard, boosters, feeders, mains, roadwork, &c., for electric lighting. Specifications from the Town Clerk on payment of £1 1s. for each of five specifications. The consulting engineer is Prof. A. B. W. Kennedy, at whose offices specifications may be seen. See "Official Notices" September 8th.

Salford.—October 17th. The Corporation is inviting tenders for about 500 central and 100 side-arm or span-wire steel tramway poles. Tenders, with drawings, to the town clerk (*pro. tem.*) Mr. L. O. Evans, Town Hall.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Swansea.—October 9th. The Corporation wants tenders for medium speed vertical engines, continuous current generators, booster and balancer. See "Official Notices" September 23rd.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

CLOSED.

Enfield.—The tender of Messrs. Stanley, Davis & Pollard for electric lighting work at the Alma Road waterworks has been accepted by the Urban Council at £159.

Hull.—The Electric Light Committee has accepted the tender of Messrs. Bannister & Co. for Hickleton Main coal for the Sculcoates Lane station at 15s. 2d. per ton. The tender of Messrs. Ream, Wokes & Co. for the wiring of the Sculcoates Lane lighting station was also accepted at £83.

Lancaster.—The Council has accepted the tender of Messrs. Mather & Platt, Limited, for a balancer at £350 and a switchboard at £65 for the electricity works.

Llandilo.—The *Contract Journal* says that the following tenders were submitted for lighting the town by electricity for the Urban District Council:—

Kite & Co., London	£3,935
A. Bayley, London	3,820
Crompton & Co., London	3,007
Fletcher, Cardiff	2,440
B. Thomas, Manchester	2,201
D. Isaac, Maindingham	2,200

London.—The Shoreditch Vestry on Tuesday considered the following tenders for the supply of 1 mile of ·25 low tension lead-covered cable:—

The British Insulated Wire Company (accepted)	£368
W. T. Glover & Co.	370
Henley's Telegraph Works Company	376

The Vestry also considered tenders from the undernoted firms for the supply of a 2-H.P. electric motor:—

	£	s.	d.
Brush Electrical Engineering Company (accepted)	47	10	0
General Electric Company	55	0	0
Electric Construction Company	59	0	0

Salford.—The Electric Light Committee of the Town Council on Wednesday recommended the acceptance of the tender of Messrs. Mather & Platt, Limited, for steam dynamos, with Browett Lindley engines, required for the Strawberry Road station, for the sum of £72,000, subject to certain conditions, and that application be made to the Local Government Board for sanction to borrow the requisite amount of money for the buildings and plant for the new low pressure generating station in Strawberry Road.

Southampton.—The Council has adopted the recommendation to accept the tender of Mr. F. Osman for the reconstruction of tramways between the Southampton Docks Station and Portswood. The following is a list of the tenders sent in:—Mr. F. Osman, £16,883; Mr. William Griffiths (London), £18,213 18s. 9d.; Messrs. A. Krauss & Son (Bristol), £20,200; Mr. Peter Smith (Manchester), £21,562 12s.

NOTES.

Opaline Lamps.—We are sorry that through a misunderstanding wrong prices have been given in the advertisement on page xxx. for the new "Opaline" lamp, manufactured by the Improved Glow Lamp Company, Limited. The prices should be 1s. 9d. for the 50 to 120 volts, and 2s. 3d. for the 200—250 volts, less usual discount.

Marriage.—Mr. J. C. Wigham, the well-known engineer to Edmundson's Electricity Corporation, Limited, was married on 27th ult. to Miss Lucy Kathleen Brown, of Saintsbridge, at the Friends' Meeting House at Gloucester.

Appointment Vacant.—The Poplar District Board of Works want a chief distributing assistant for the electricity department, at £156 per annum. See "Official Notices" this week.

Junior Electrical Engineers.—A new society, known as the Junior Electrical Engineers' Society, held its first annual general meeting at Manchester on Tuesday last week, when the following gentlemen were elected as officers for the session 1899-1900:—President, W. W. Haldane Gee; secretary, H. Rust; treasurer, A. Joannidi; librarian, J. G. Bagot; committee, Messrs. S. Payne, A. Blackburn, D. G. Nye, H. T. Wilkinson, A. Rothwell, and S. Utting. A set of rules were drawn up, and will shortly be printed for distribution amongst the members. The next meeting of the Society will be held on Tuesday, October 31st, when a paper will be read by Mr. S. Payne on "Steam Condensers as Applied to Electrical Engineering." Candidates for admission to the Society should make application to the honorary secretary, 13, Harcourt Street, Gorse Hill, Stretford.

The Sunderland Tenders.—The following reaches us from a correspondent:—"Last month the Sunderland Electric Lighting Committee asked for tenders for three 250-KW. steam dynamos complete with surface condensers, cooling tower, &c. The work has been given to the Sunderland Forge and Engineering Company, but the list of tenders has not been published, as is usual in these public contracts; in fact, we understand that the Council have made a special order that they shall not be published. Surely those firms who have gone to very considerable expense in quoting should be furnished with a list of the tenders, even if the information is not published in the technical press. We think, however, that in order to prevent any suspicion of jobbery, it is essential that the results of tenders should have publicity. Only by this means can the methods of our municipalities remain clean and above-board. Of course, it is natural that preference should be given to a local firm, but if a Corporation put outside firms to the trouble of tendering, then it is only fair that in adjudicating, local influence should be kept in the background—at any rate, let us have the results of the tenders published."

The Electric Lighting of Churches.—Chancellor Espin, at the Liverpool Consistory Court, ruled last week that the incumbent, churchwardens, &c., of a church have not legal power to substitute one method of illumination for another without having obtained a faculty for the alteration. The Chancellor proceeded to show that the hardship was not so great as some might imagine, because many matters might be covered in one faculty. The matter arose at the Liverpool Court on the statement of Archdeacon Madden, that in recent years about half-a-dozen churches in the diocese had substituted electricity for gas lighting, without thinking of the faculty question.

Pneumatic Despatch Tubes.—At a meeting of the Langbourn Ward Club on Wednesday evening, October 4th, at the London Tavern, Fenchurch Street, E.C., papers were read by Mr. Geo. Threlfall, M.I.Mar.Eng., M.I.M.Eng., and Prof. Carus-Wilson, M.I.E.E., &c., "On the Resuscitation, after Thirty Years' Disuse, and the Electrical Equipment of the old underground Pneumatic Despatch Tube between Euston Station and the General Post Office—a distance of 2¼ miles." Mr. Threlfall dealt with the commercial aspect and importance of the re-equipment and extensions of the tube, and Prof. Wilson with the electrical view of the matter, with other details of interest.

The City Company's Continuous Current Service.—We hear that at the present time the City of London Electric Lighting Company is supplying continuous current within the central streets of the City for motors equivalent to 200 H.P., and by the end of the year the company will have three 1,000-KW. continuous current sets running.

Lectures.—At 8.30 p.m. on Monday, October 9th, Prof. C. A. Carus-Wilson, B.A., will commence a course of 10 weekly lectures on "The Direct Current Motor," at the South-Western Polytechnic, Chelsea. The fee for the course is 5s. See our "Educational Notices" this week.

On Tuesday evening, October 3rd, a lecture on "Electricity as a Motive Power for Printing Machinery," was delivered by Mr. H. Scholey before the Printers' Managers and Overseers Association, at the Albion Hotel, Ludgate Circus, E.C. The lecture was illustrated by limelight views.

Personal.—We understand that Messrs. T. O. Mullings and F. H. Wilson, of Messrs. Crompton, have been appointed electrical engineers to the Mansourah Electric Lighting Company, Egypt. They sail to-day (Friday) by P. & O. *India*.

Class Experiment Showing How the Resistance of Carbon Falls with Rise of Temperature.—Mr. J. J. Kavanagh, S.J., of St. Mary's College, Montreal, writes to the *Scientific American* as follows:—"I am in the habit of giving an illustration of the decrease of resistance in carbon with increase of temperature, which commends itself by reason of its effectiveness and simplicity. In a 110-volt circuit, I introduce a piece of charcoal some 4 or 5 inches long. The spark produced upon short circuiting this stick at one of the contacts ignites the charcoal there. Then I slowly draw the short-circuiting wire from the ignited point zigzag along the surface to the end. The glow follows the wire and is maintained. Thus the current keeps to the path it has 'blazed' for itself throughout all the 15 or 16 inches of meandering, preferring the road that is hot, though long, to the short but uninviting chilliness of the straight line."

Therapeutic Properties of Alternating Currents.—At the recent Congress of the French Association for the Advancement of Science at Boulogne, a paper on "The Undulatory Alternating Current: Its Therapeutic Properties," was contributed by Drs. G. Gautier and J. Larat. The authors said that the alternating current may be represented as a function of time by a sinusoidal curve characterised by its effective intensity and its frequency. What specially characterised this current is really the progressive manner in which it increases and decreases. This is its characteristic quality, and the one to which must be attributed the special physiological and therapeutic effects observed in connection with it. In 1895, taking as their basis the experiments of Prof. d'Arsonval, the authors conceived the idea of applying this current to the entire service of the body by means of the hydro-electric bath. Their results, subsequently published, have met with no contradiction. They now draw attention to the comparison which they have been making for five years between the therapeutic action of these currents and that of alternating currents of high frequency. It is true that in certain local affections the current of high frequency obtained by means of the Oudin resonator is an excellent therapeutic instrument, but as far as general effects are concerned, they think that the opinions expressed affirming the superiority of high frequencies, especially in diseases of an arthritic nature, have been somewhat premature. A long experience leads them to believe, at any rate at present, that the superiority of high frequencies over the ordinary alternating current does not exist.

Indian Electric Power Scheme.—Reuter's agent at Bombay telegraphs that, in connection with the scheme for utilising the power of the Kaveri Falls, the Mysore Government has offered to supply mining companies on the Kolar goldfields with electric power free of charge for one year. This means a saving of £360,000. The cost of the scheme is roughly estimated at 24 lakhs of rupees.

Electric Power of the Rhone.—We read in a New York exchange that, though but partly completed, the plant of the Société Lyonaise de Force Motrice du Rhone has now 504 contracts for power, amounting to 2,465 H.P., and 834 contracts for current for lighting, equivalent to 36,266 10-C.P. lamps. Of the above 1,303 H.P. and 21,810 lamps are now being supplied.

Tests of a Three-Phase Railway.—We understand that Prof. Carus-Wilson has been making a series of tests of the three-phase equipment on the Burgdorf-Thun Railway, assisted by engineers representing the railway company and Messrs. Brown, Boveri & Co., who installed the electrical apparatus. The special object of the tests was to determine the behaviour of the three-phase motors during the process of acceleration.

Will.—The will of Sir Edward Frankland, K.C.B., F.R.S., &c., who died on August 9th, has been proved, and the estate is sworn at £138,627 3s. 11d., of which £126,471 10s. 6d. is net personalty.

Aluminium for Electric Railway Work.—"R. A.," of Cleveland, Ohio, writes to our New York namesake regarding the employment of aluminium for electrical conductors. He says that on the inter-urban road, which is being built between Kansas City and Leavenworth they are using 76 miles of 350,000 circular mils. aluminium cable, purchased from the general manager of the Pittsburg Reduction Company. The field for aluminium has appealed to "R. A." so strongly that he is now devoting himself to the sale of aluminium wire for electrical conductors.

Electrical Treatment for Lead-Poisoning Cases.—The *Daily Chronicle* in a brief article says that the electrical bath treatment to which a number of lead-poisoned patients have been subjected at Wolverhampton is showing exceedingly satisfactory results. In several cases the improvement in the condition of the patients has been very marked.

J. Bowman Lindsay.—The *Pall Mall Gazette* says that a bust of James Bowman Lindsay, whose work in wireless telegraphy is now pretty well known, is to be placed in the Victoria Art Galleries, Dundee. The cost is to be borne by Lord Provost M'Grady. It is also proposed to erect a monument in Dundee by public subscription.

CITY NOTES.

Tunbridge Wells Corporation Electricity Accounts.

Public lighting and private supply.

Tunbridge Wells Corporation has, in its electricity supply business, a progressive undertaking, and the engineer, Mr. Boot, deserves to be well treated at its hands. From the borough accountant's report we extract the following figures, showing the percentage increase for last year over the previous year:—

Increase. Consumers.	Increase. Revenue.	Increase. Expenditure.	Increase. Gross profit.	Increase. Net profit.
25 per cent.	27 per cent.	23 per cent.	30 per cent.	34 per cent.

These figures show that the reductions in price of electrical energy so strongly urged by Mr. Boot, are appreciated, and it is rather a matter of regret that the Council are so strongly in favour to handing over nearly a thousand pounds to the rates, despite the arguments against treating the department as a profit-yielding business. One penny on the rateable value of the borough may sound very pleasant to the ears of the ratepayers, but, with the engineer of the Corporation, many would regard it as better finance to create a reserve fund and materially reduce the price charged. Another feature of the report that strikes the outsider is the meagre street lighting. Some 60 arcs is a small advertisement for a resort of the standing of Tunbridge Wells. There seems to be some inexplicable dislike to arc lighting on the part of some members of the Council, who would probably change their opinions were they to take a trip and see how arc lighting is going ahead, while, near at hand, Brighton is an example which ought to carry conviction.

The small total capital expenditure is one of the features of the accounts, the general particulars of which may be summarised thus:—

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£31,275	£37,818	£6,543
Number of units sold	258,641	334,709	76,068
Number of lamps connected ...	18,044	24,000	5,956
Gross revenue	£5,822	£7,381	£1,559
Gross profit	£3,049	£3,895	£846
Average price per unit sold ...	5·21d.	5·12d.	—·09d.

The sale of current for public lighting (after deducting from the gross amount received, the expenditure for attendance, carbons, and repairs) is not by any means charged at an exorbitant rate, the amount received per unit being 2·33d. in 1897, and slightly over 2¼d. in 1898, while the average price for private lighting only was little more than 5½d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£5,620	5·21d.	£7,138	5·12d.	—·09d.
Meter rents	170	·16d.	209	·15d.	—·01d.
Supply of ashes, &c. ..	20	·02d.	8	...	—·02d.
Sundry	12	·01d.	26	·02d.	+·01d.
Gross revenue ...	£5,822	5·40d.	£7,381	5·29d.	—11d.

The net profit in 1897 was £1,635, and in 1898 £2,172, after paying interest at 3 per cent. and redemption at about the same rate. These figures seem to have attracted the attention of the Finance Committee, as the proposal was actually made to make a charge of £250 for rent of offices and services rendered by the town clerk's and borough accountant's departments. The price in 1898 was 6d. per unit for the first two hours daily and 3d. per unit after. This has been modified by dropping the second hour to 3d.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	£1,386	1·29d.	£1,351	·97d.	—·32d.
Oil, waste, water and engine room stores.	141	·13d.	146	·11d.	—·02d.
Salaries and wages incurred in generation and distribution.	525	·49d.	632	·45d.	—·04d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	100	·09d.	155	·11d.	+·02d.
Works' cost ...	£2,152	2·00d.	£2,284	1·64d.	—·36d.
Rent, rates, and taxes ..	127	·12d.	213	·15d.	+·03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	351	·32d.	814	·58d.	+·26d.
General establishment charges, stationery and printing, law charges and insurance.	121	·11d.	175	·13d.	+·02d.
Other expenses	22	·02d.	...	...	—·02d.
Total costs ...	£2,773	2·57d.	£3,486	2·50d.	—·07d.

We are glad to see the item for coal so largely reduced on a comparatively small output, and also to note that salaries shows a tendency to increase. If we mistake not, Tunbridge Wells once expected to get assistant engineers at the rate of £50 per annum. As Mr. Boot stated in his 1897 report, "it is only just to our men that they should share in our good fortune." In dealing with the accounts, it may be noticed, however, that only a portion of the chief engineer's salary is shown under "Management expenses" in 1897, whereas it is all charged under this heading in 1898.

Profit Statement.

	1897.	1898.
Interest on loans	£742	£890
Sinking fund for repayments	672	833
Net profit, carried to credit of rates	900	900
„ being surplus	735	130
„ expended in increasing pressure, demand indicators, &c.	...	1,142
Gross profit	£3,049	£3,895

Halifax and Bermudas Cable Company, Limited.

The following report was unanimously passed by the shareholders at the meeting held on September 28th, at 33, Old Broad Street, E.C.:—"The directors beg to submit to the shareholders duly audited statements of account for the year ending June 30th, 1899. In the earlier part of the year the receipts were greatly augmented by the Spanish-American war, and subsequently the company's revenue was favourably affected by the interruption of other routes. On the other hand, some loss has resulted from the reduction in August, 1898, of the charge for messages between Halifax and Bermuda from 3s. per word to 1s. 6d. The net result of the year's working is a profit of £10,141 19s. 10d., as compared with £6,655 0s. 8d. for the previous year. An interim dividend of 2½ per cent. has already been paid, and it is now proposed to make a further equal payment, which will together absorb £2,500, and leave £7,641 19s. 10d. to be carried forward. This will increase the amount to the credit of revenue account to £11,797 0s. 6d. The directors regret to have to report that, so far as the new year has gone, there is shown a serious falling off in the receipts, chiefly as the result of the discontinuance of the special aids to revenue described above, and partly to interruption of connecting lines beyond Jamaica. In the nine weeks from July 1st to September 2nd, the reduction in traffic receipts is as much as £4,510. The company's own cable has worked with complete efficiency. Offers for the sale of debentures to the trustees were invited in December and June last, and £4,988 15s. 2d. was paid for £5,000 of debentures, which amount has been written off capital expenditure. Mr. T. G. H. Glynn and Mr. Thomas Skinner retire on this occasion, and, being eligible, offer themselves for re-election. The auditors, Messrs. Gribbon, Holroyd and West, retire, and offer themselves for re-election.

Direct West India Cable Company, Limited.

The following report was unanimously passed by the shareholders at the meeting held on September 28th, at 33, Old Broad Street, E.C.:—"The directors beg to submit to the shareholders duly audited statements of account to June 30th, 1899. The receipts of the company were abnormally increased in the early part of the year by the Spanish-American war, and subsequently by interruptions to other routes. The net result is a profit of £19,186 1s. 1d. An interim

dividend of 2½ per cent. has already been paid, absorbing £750, and it is now proposed to make a further equal distribution, which will leave £17,686 1s. 1d. to be carried forward, thereby increasing the amount to the credit of revenue account to £21,490 16s. 10d. Since the close of the company's financial year, a most important falling off in the traffic receipts has taken place. Not only have the exceptional sources of traffic referred to above been discontinued, but interruptions to connecting lines beyond Jamaica deprived the company of through traffic for the time being. In the nine weeks from July 1st to September 2nd, there is a falling off, as compared with last year, of as much as £14,156. The company's own cables have worked with complete efficiency. Mr. C. R. Hosmer and Mr. Thomas Skinner retire on this occasion, and, being eligible, offer themselves for re-election. Messrs. Gribbon, Holroyd and West, the auditors, retire, and offer themselves for re-election.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to:—Electric Lighting and Traction Company of Australia, Limited, 20,000 6 per cent. cumulative preference shares of £5 each; Thames Ironworks Shipbuilding and Engineering Company, Limited, 300,000 5 per cent. cumulative preference shares of £1 each, and £200,000 4 per cent. irredeemable first mortgage debentures; and to allow the following securities to be quoted in the Official List:—Aluminium Company, Limited, 5,000 shares of £1 each, fully paid, Nos. 60,001 to 65,000; Edmundson's Electricity Corporation, Limited, 8,700 vendors' ordinary shares of £5 each, fully paid, Nos. 17,408 to 26,107. The Committee have appointed special settling days as under:—Thursday, October 12 h.—Giffre Electro-Chemical and Power Company, Limited—110,000 £1 shares, fully paid, Nos. 20,001 to 130,000. Nernst Electric Light, Limited—115,000 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 115,000. The Giffre Company's securities are also to be quoted in the Official List.

Anglo-American Telegraph Company, Limited.—The directors have resolved, after placing £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending September 30th, 1899, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on November 1st, to the stockholders registered on the books of the company on September 30th, 1899.

The Eastern Telegraph Company, Limited.—The directors have announced the payment on 13th inst. of a dividend at the rate of 3½ per cent. per annum, less income-tax, on the preference stock for the quarter ending 30th inst., and the usual interim dividend of 1½ per cent. on the ordinary stock, free of income-tax, in respect of profits for the quarter ended June 30th last.

Barcelona Tramways Company.—The directors have been offering to their shareholders 7,000 5 per cent. cumulative preference shares of £10 each, the balance of a total of £100,000 authorised in 1896, for subscription at par.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 30th, 1899, were £768 2s. 4d.; receipts for week ending September 30th, 1898, £683 18s. 4d.; aggregate for half-year to date, £17,536 0s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 29th, 1899, were £3,059 17s. 3d.; corresponding period, 1898, £2,958 7s. 3d.; increase, £101 10s. 0d.

The City and South London Railway Company.—The receipts for the week ending October 1st, 1899, were £963; week ending October 2nd, 1899, £955; increase, £8. Total receipts for half-year, 1899, £13,164; total receipts corresponding period, 1898, £13,267, decrease, £103. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 30th, 1899, were £210 13s. 0d.; week ending October 1st, 1898, £209 5s. 8d.; increase, £1 7s. 4d. Total receipts to date, 1899, £7,872 14s. 0d.; corresponding period, 1898, £6,416 15s. 4d.; increase, £1,455 18s. 8d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,864; 1898, 4,085. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 29th, 1899, were as follows:—D. U. T. Co., horse cars, £1,064 18s. 3d.; ditto, electric cars, £1,933 19s. 10d.; D. S. D. Co., electric cars, £785 4s. 1d.; total, £3,782 2s. 2d.; corresponding week last year—D. U. T. Co., horse cars, £2 379 17s. 1d.; ditto, electric cars, £424 15s. 10d.; D. S. D. Co., electric cars, £873 15s. 10d.; total, £3,678 8s. 9d.; increase, £103 13s. 5d. Aggregate to date, £59,131 3s. 9d.; aggregate to date last year, £57,430 14s. 2d.; increase to date, £1,700 9s. 7d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 80 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 1st, 1899, were £570. Miles of track open, 10. Car miles run, 11,493. Number of cars, 21. The receipts for the week ending October 5th, 1898, were £261. Increase, £309. Miles of track open, 3½. Car miles run, 3,565. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £15,750; total receipts to date, 1898, from June 29th, 1898, £3,964.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 1st, 1899, amounted to £1,481: corresponding week last year £1,597 (visit of Channel fleet); decrease, £116.

The South Staffordshire Tramways Company.—The receipts for week ending September 29th, 1899, were £709 9s. 11d.; aggregate receipts for 39 weeks, £25,962 4s. 5d.; week ending September 30th, 1898, £666 5s. 10d.; aggregate receipts for 39 weeks, £24,612 14s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

These are days of war markets. Consequent upon the fear of hostilities in the Transvaal there has arisen a sudden scare of dearer money, the action of New York further assisting this cause of anxiety. The two combined have been altogether too much for what verve the Stock Exchange had left to it after the past few months of unrest and trouble. For Consols to fall two points in the same number of days was sufficient to rock all markets in the House, particularly those whose strength lies to a great extent in the fact that their shares are sound enough to warrant the price returning only a small rate of interest to an investor. To this class, of course, belong most of the Electrical Supply shares, and immediately the raising of the Bank Rate was announced in the Stock Exchange, a thorough weakening set in even amongst the best of them. With the official minimum standing at 4½ per cent., it is scarcely likely that investors will keep securities that yield less than this rate, unless by selling they incur a heavy loss, and some are not unwilling to do this, believing that the "war-panic day" has not yet come. Whether it has or not no one can tell, but there is a fortune ready made for the investor who strikes the psychological moment for buying when things are at their very worst.

Weakness has been most pronounced in Chelseas, House-to-House and Westminster, which are all 10s. lower. Other shares in this department maintain their nominal quotations, but sellers are constantly disappointed at finding their orders executed below the price officially named. The market must not be blamed for this. Rather it is the result of weak holders rushing in to realise at a time when there is naturally no public buying. It is difficult not to sell when falls are recorded day after day, but the reaction is inevitable, and a little patience in seeing the fall through is the best antidote against this eagerness to sacrifice shares at any price. Charing Cross new Ordinary settle on Thursday, October 12th, and are to be quoted in the List, but no change is marked in the price of the old shares. We attempted to extract some definite information the other day from a member of the Marylebone Vestry, with regard to the negotiations now on foot between that body and the Metropolitan Electric Supply Company, but he said that the scheme was too intricate for the Vestry to pronounce judgment upon at present. The Lighting Committee is now hard at work on the task of marshalling all the pros and cons of the case.

In the electric railway market Central London shares have fallen, and the quotation for City and South is warily widened, but Waterloo and City remains unchanged, its recent falls having brought it to a level, below which it is unlikely to sink further. Home rails, on the whole, have exhibited such unmistakable flatness at the dear money scare, that it is surprising that so slight a fall should have overtaken the electrical section. There is after all some advantage for a stock to possess a narrow market.

Telegraph issues are giving way in nearly every direction, but an improvement has to be noted in the senior securities of those companies whose ordinary stocks are flat. For example, Eastern 4 per cent. Mortgage Debenture is up 1, as is also Eastern Extension 4 per cent. Debenture. Heavy declines occurred in the Anglo-American Telegraph Stocks, despite interim dividend and the business which the company is doing in connection with the famous yacht races. Commercial Cable has moved up a point, on what is believed to be a buying order from "across the herring pond." The depression in telegraph stocks has affected Globe Telegraph and Trust shares. Both Ordinary and Preference have shed ¼, but there is no change in Submarine Cables and Trust. Reuters are also unmoved, but the shares remain steady at 7½, and the international events now passing should be a good wind to the company. National Telephones have been easier, but firmed up again. It is not thought that the concessions to be granted to provincial subscribers next year will materially affect the company's business.

Traction and Tramway shares participate in the prevailing dullness. British Electrics are now quoted, *ex* the dividend of 9s., and the price has not recovered the deduction, as it most likely would have done in healthy times. We hear that a market will shortly be made in the shares of the Seville Tramways, a Spanish company which has just opened the first section of electric tramways to general traffic. It seems a pity that one of the British companies could not have secured the contract for the line's construction instead of a German concern. But that the home undertakings are not behindhand in enterprise is apparent from the fact of Callender's Cable Construction negotiating for the purchase, with the Westinghouse Electric Company, of an Adelaide tramway system. Brush Second Debenture has advanced two points. Henleys are no weaker at 14, and 10s. is the nominal price of Nernst Electric.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Sept. 27th.	Closing Quotation, Oct. 4th.	Business done during week ended Oct. 4th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	113½—114½	111½—112½	114	111½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14¾	13½— 14	13⅞	13¾
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14¾— 15¼	14¾— 15¼	15	14¾
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	185 —190 xd	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	102 —104 xd	...	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9 — 10 xd	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	3½ %	11¾— 12¼	11½— 12 xd	12	11⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	142 —147	140 —145	144½	140¾
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	99¾	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	118 —123	121¼	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	13¾— 14¼	14	13¾
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	101	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	10⅜— 11¼	10½— 11	10 1/16	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14¾— 15¼	14¾— 15¼	15½	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13¾	13½
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5⅛— 5⅜	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅝	10¼— 10⅝	10⅝	10½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¼— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10⅜	10½
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7 — 8	7 9/16	7½
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —112	110 —112	111	110¾
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅜	11⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	10⅜— 11½	11 1/16	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	81 — 84	81⅝	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	7½— 8½	8	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9⅜	9⅛
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6 7/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14½— 15½	15½	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	14⅜	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	16 — 17	16½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3¾— 4¼	3¾— 4¼	4	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 —16	14½— 15½	15⅝	15½

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid.
‡ Dividends paid in deferred share warrants, profits being xred as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 27th.	Closing Quotation Oct. 4th.	Business done during week ended Oct. 4th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	95 —100 xd	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17 — 18 xd	17	...
33,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 14	14	13⅛
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	125 —128 xd	127¼	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2	1⅝— 2	1⅛	1⅛
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅜	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —104	104 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13½— 14½	13½— 14½	14⅛	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10 — 10½	10⅜	10⅜
178,303	Do. do. do. £8 paid	10	...	...	...	.. ..	...	...	...
61,033	Do. do. Pref. half-shares ...	5	...	...	...	4⅜— 5¼	4½— 5	...	..
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅜	5 — 5½	...	...
630,000*l*	City and South London Railway	Stock	1⅝%	1⅞%	2⅛%	64 — 66	63 — 65	64	63⅞
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3¹⁵⁄₁₆	3½
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105¼	105
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅜ — ⅝	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅞	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104 xd	100 —104 xd	102	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	3½%	8⅜— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13¾	13¼— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	9¼	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅜— 6 xd	5½— 6 xd	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	100 —103	102	101

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10
British Aluminium, Ordinary, 9½—10; 7 % Pref., 9—11.
House-to-House, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅝. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, October 4th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric	per cwt.	5/-	5/-	..
" Nitric	per cwt.	22/-	22/-	..
" Oxalic	per cwt.	32/-	32/-	..
" Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal)	per ton	£25	£25	..
a " "	per ton	£23	£23	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£27	£24	£3 inc.
a Lead, Nitrate	per ton	£33 10	£33 10	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£37 10	£37 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3½d.	3½d.	..
a " Caustic (75/80 %)	per ton	£24	£24	..
a " Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£7 10	£7 10	..
a " Crystals	per ton	£3	£3	..
a " Bichromate, casks	per lb.	2½d.	2½d.	..
METALS, &c.				
Aluminium Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis	per lb.	8½d.	8½d.	..
c " Tube (brazed)	per lb.	10¾d.	10¾d.	..
c " Wire, basis	per lb.	8¾d.	8¾d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£88	£88	..
g " Wire (basis price)	per lb.	10½d.	10½d.	..
g " Sheet	per ton	£88	£88	..
g " Rod	per ton	£88	£88	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine	per lb.	4/2½ to 4/4½	4/2½ to 4/5	½d. dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	66/7	67/10½	1/3½ dec.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£15 15	£15 5	10s. inc.
g " Sheet	per ton	£16 10	£15 7½	32/6 inc.
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bott'e	£8 12	£8 12	..
d Mica (in original cases), small	per lb.	2d. to 6d.	2d. to 6d.	..
d " " medium	per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " large	per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
c Platinum	per oz.	£3 10	£3 10	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£110	£149 10	10s. inc.
g " foil	per lb.	1/6	1/6	..
n " wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals—				
"White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb	7¾d.	7¼d.	½d. inc.
j " Best Flax, 6 lea.	per lb.	4½d.	4½d.	..
j " Hemp, 2 ply 10 lbs.	per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove	per ton	£13	£13	..
j " Manila, 24 thread	per ton	£39 10	£39 10	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE BRITISH ASSOCIATION.

SIGNALLING WITHOUT CONTACT.

A System of Railway Signalling specially suitable for Fog Signalling.

Paper read before Section G on Monday, September 18th, by Mr. W. S. Boult, Assoc.M.Inst.C.E.

(*Concluded from page 537.*)

Road Circuits.

Referring now to fig. 20 (in which permanent magnets are shown by single and electro-magnets by double circles) it will be seen that at each signalling position the engine first gets the danger signal—distant or home as the case may be, according to the polarity of the permanent magnets—immediately followed by "Line Clear" and a road number if current is on the electro-magnets. If current is not on, the danger signal only is taken.

The diagram shows the arrangements at a junction, each branch from which leads to another junction. Equivalent roadside semaphores are also shown.

To economise current it may be switched on and off in the signal boxes A and B by means of the apparatus indicated, so that it is used in a section only whilst the train is there. In each signal box is a key, or plunger, for throwing magnetic switches (constructed like the indicator movement above described, but not permanently polarised, and therefore workable by current in either direction) to close their respective circuits through contacts on pendent tongues and the cores of the lowest coils—taking the view as a front elevation. In each switch the tongue working between the two upper coils acts simply as a tumbler to move the pendent contact-making tongue through a small angle. On plunging, the tumblers will all be thrown into the position shown, and the respective circuits be all earthed. This will be done at each signal box on the approach of a train.

Suppose now that a line has to be cleared for an approaching train. The magnetic switches will be in the opposite position to that shown, with road circuits open.

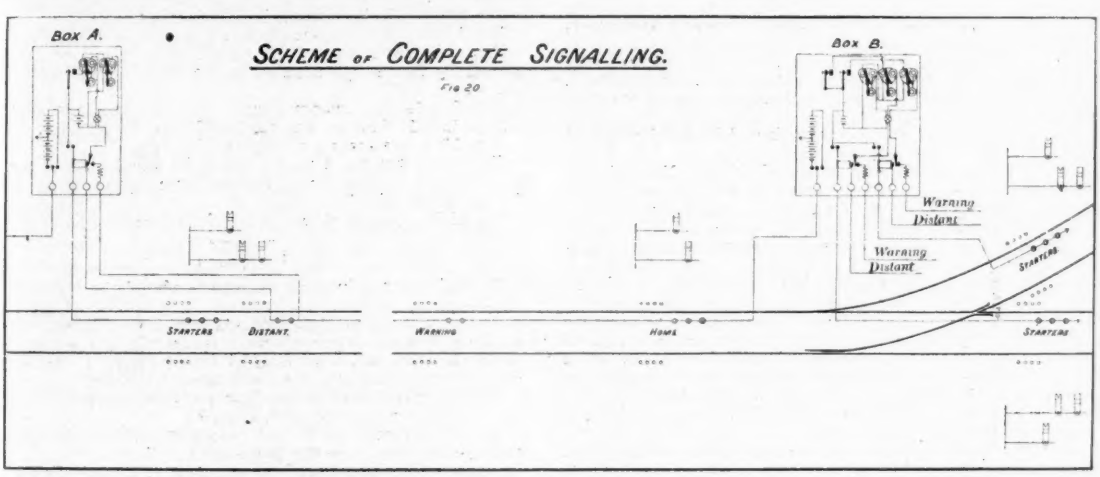
Signalman A switches in the battery for his starter magnets and B the battery to give the required polarity to the distant, warning, and home magnets. As the train comes near, A plunges (just before giving B the train-on-line signal), and thus completes the circuits through the magnetic switches, and current flows, the starter current immediately cutting in the distant magnets by the intermediate switch, as will be readily understood from the diagram. Current now flows through the two right-hand coils of each magnetic switch, whereby the pendent contact tongue is held hard up, and the tumbler is thrown over to the right, till held by its knuckle joint. As soon as the train has passed A, he breaks the starter circuit, so as to put this signal on. By means of the intermediate switch the distant signal is also immediately put on. Current ceasing in the right-hand coils of the left-hand magnetic switch, the pendent contact tongue is released, and pulled back by the weight of its tumbler. A similar action takes place in the other switch when B puts on the warning and home signals. In order that the right-hand magnetic switch may not be opened too soon, the intermediate switch may be constructed so as never to break one circuit till it has closed the other.

In the diagram small circles in the signal boxes represent galvanometers for showing when, which, and how much current is flowing in each circuit; that is in effect for "repeating." Crossed circles stand for "veto" switches, whereby a signalman, if he sees anything wrong with a train as it passes, can instantly veto line-clear signals given by the man in advance, without wasting time in communicating with him.

For the number of branch lines shown, electro-magnets for one armature only are required. Where more than two diverging roads have to be signalled at the same spot, the other inside armature also must be utilised by another set of electro-magnets. It is then possible to select from eight different roads as follows:—

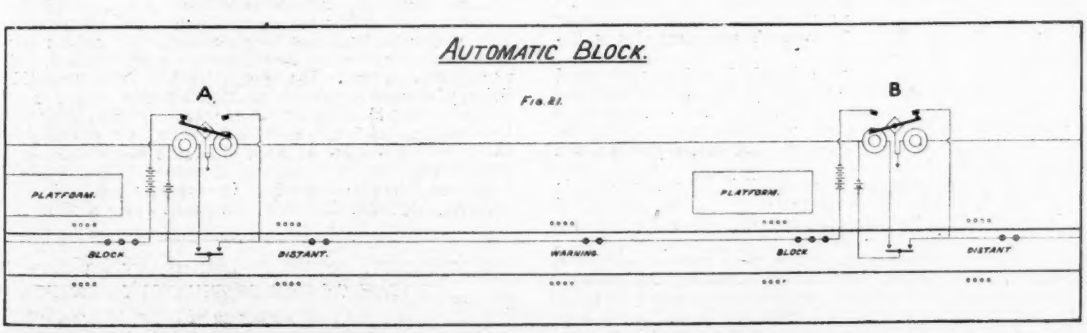
Let the four numbers of the indicator controlled by the two armatures be respectively M2 and 1 on one armature and 2 and 5 on the other, then:—

Branch No. 1 = 1.
" " 2 = 2.
" " 3 = 1 + 2.
" " 4 = M2 + 2.
" " 5 = 5.
" " 6 = 1 + 5.
" " 7 = M2 + 5.
Main Line = M2.



SCHEME OF COMPLETE SIGNALLING.

Fig. 20.



AUTOMATIC BLOCK.

Fig. 21.

In any exceptional case requiring more than eight road indications, if such can be found, a second set of magnets to one of the armatures can be provided giving two more, thus:—

Branch No. 8 = 1 + 2 + 5.
" " 9 = M2 + 2 + 5.

By doubling the magnets of the other armature as well, one more is obtainable, thus:—

Branch No. 10 = 1 + M2 + 2 + 5.

A total of 11 roads can thus be differentiated if necessary—probably more than will ever be wanted under any circumstances.

With the indicator above described (see fig. 7), the home semaphore on is an invariable order to stop; when off it signifies "Go," the distant arm pointing to "slow" or "fast," according as it is on or off. It is only when moving out of a block section up to a starter that this interpretation of the distant arm does not strictly hold, as the starting signal will be off or "fast;" but as in this case the train *cannot* be going fast, the giving of permission to do so does no harm.

With the arrangement of road magnets shown in the diagram, the working of traffic is as follows:—

Suppose a train travelling from A to B and finding the signals on. On receipt of the distant signal, speed will be slowed down in the usual way. The "warning" magnets (which might be, perhaps, 200 yards in rear of the home magnets) will throw on the home semaphore, and the train will be brought to a stand. After stopping, it will crawl up the home magnets or block station, and stand over the electro-magnets of this group, which, as shown by the third magnet, may have an extra long pole-plate. The bells may now be stopped by the "relay-push." As soon as current is switched on to the road-magnets, the starting signal will be given by the throwing off of both semaphores and the appearance of a road number; the "relay-push" being at the same time again closed ready for the next danger signal.

A simple scheme of automatic block signalling is shown in fig. 21. At or near each block station is a two-point magnetic switch, conveniently formed with the polarised movement above described, controlled by road armatures operated by magnets on the train.

As the train comes up to each switch, it finds it in the position shown at station A, and by means of its front magnet, throws it into the position shown at station B, thus breaking the circuit of the magnets behind it and earthing both the rear end of the magnet wire in front and the other contact of the armature being passed. The tail magnet of the train on coming up closes the needle on this contact, thereby completing a circuit through the right hand coil of the switch in rear. The diagram shows the position of the switches when a train has completely passed station B. A following train coming up to A, will earth the rear of the magnet wire A—B, but the forward end will not be earthed until the leading train has reached station C; the following train being meanwhile blocked at the platform in rear of B.

This scheme thus ensures that the whole of one train must have passed out of a block section before another is allowed to enter it, and uses current in each section only whilst a train is in it.

Such a system as that outlined in figs. 19 and 20, compared with the usual methods of semaphores, coloured lights, and detonators, possesses most substantial advantages as the regular every-day method of working.

In the first place, it is *one* system for *day, night, and fog*, instead of *three systems as now used.*

Obviously, such a simplification is most desirable. Not only are the first cost and working expenses thereby reduced, but there is distinctly less chance of mistakes being made, and there is *no* chance of the system required in any particular moment not being got ready in time, there being no lamps to light, and no foggers to call out.

Then, the signal is always given in the same spot, and only the signal for the one train, so that the driver's attention is not distracted from his engine, and a general look-out ahead to peer out anxiously and constantly, often through fog, snow, hail, rain, and wind, trying to see in what direction a continual succession of arms on top of posts are pointing, or what coloured lights are visible at frequent intervals, and decide which arms or which lights (often out of a large number in view at the same time, when not all obscured by fog or snow) refer to his train.

Again, if the present distant and home signals are on separate posts, there is nothing at night to indicate to a driver which it is he is approaching, so that there is always the chance of his mistaking a home "danger" light for a distant "caution," and so running past when he should stop. With the author's apparatus this is impossible.

There can be no two opinions as to which system, with equal reliability of action, is the safer; and railway engineers and managers should gladly welcome a system giving signals on the trains where they are wanted, instead of on the roadside where they are not wanted, if they only can have confidence in the certainty of its action under all circumstances.

This raises the question of relative simplicity of construction, in which it will be noticed the advantage is all on the side of the author's system. The parts on the road are simply the boxed-in magnets and connecting wires, with no moving parts, as against a combination of signal wire and pulleys, post, ladder, lever, rod, semaphore, spectacles, lamp, "fogger," and detonator, an accident to almost any part of which will throw the apparatus out of order. Further, the magnets are completely encased, and so protected from accident, while the whole of the semaphore apparatus is thoroughly exposed to wind and weather and mechanical injury; indeed, the same may be said of the unfortunate foggers. The receiving apparatus carried by the train consists of parts, the management and keeping in order of which are well understood, and which are all carefully boxed in, so as to be protected from damage; besides being of so small and simple a nature as to admit of duplication.

The author's apparatus thus consists of the simplest and best protected parts possible, producing an absolutely unfailing field, acting on *at least two* independent contact makers, the proper working of *one* of which ensures safety. Beyond doubt this is immeasurably safer than a signal which cannot be seen at all in thick fog or snow, is liable to fail any night by the accidental extinction of a lamp remaining unnoticed by the signalman for a little while, and at the best of times has to be carefully discriminated from other signals, in many cases distributed round it in profusion.

It is needless to detail to those in any way connected with railways the numerous accidents that have occurred, and *nearly occurred*, through drivers mistaking their signals or being unable to see them.

A further most important point in favour of such a system as the author's is the great reduction thereby to be effected in "fogging" expenses as incurred under the present method, to say nothing of oil, gas, and attendance for the present signal lamps, and cleaning, oiling, and adjusting for the wires.

Finally, the cost of this system for new lines would be very small compared with the expense hitherto necessary.

It is, however, a good fog signal that is the pressing want, and the author trusts he may be forgiven for adding to this already very lengthy paper a few words as to the relative costs of the present and proposed systems.

As mentioned above, Sir George Findlay states that on the London and North-Western Railway in the great fog of 1888 (which lasted five days) 2,462 posts were dealt with. This gives an average of about 1⅛ post per mile of road. Mr. Acworth gives the cost of the same fog to the Manchester, Sheffield and Lincolnshire Company as £1,250. Assuming the same ratio of posts to mileage, this sum would be divided among 470 posts at the rate of £2 13s. 2d. per post for the five days' fog. The author is not in a position to quote definite figures for his system, but he feels little doubt that for this sum of £2 13s. 2d. per *annum* (not per fog) it could be permanently maintained, giving twice the number of signals (both danger and line clear) at twice the number of posts (distant and home). The "complete" system, giving routes and repeating, would no doubt exceed this figure.

In order to test the working of the armature-relay and indicator movements, four groups of electro and permanent magnets were put down on the up fast road of the Great Northern Railway at New Southgate, and an express engine (No. 1,008) was fitted with two armatures, indicator and bell. Although the apparatus was in many respects inferior to the designs now put forward, signals were taken perfectly at speeds of over 70 miles an hour, with a clearance of over 3 inches between armatures and road magnets.

List of Drawings.

Fig. 1 is a plan showing groups of permanent and electro-magnets on the road.
Fig. 2 shows electro-magnets in side elevation.
Fig. 3 shows permanent magnets in side elevations.
Fig. 4 is a cross section of the same, showing also four armatures carried by iron straps attached to the ash-pan and frame of the engine.
Figs. 5 to 10 show the construction of the indicator on the engine.
Figs. 11 to 15 show the construction of the armature relay.
Figs. 16 to 18 show the "relay-push."
Fig. 19 is a diagram of engine circuits for complete signalling.
Fig. 20 is a diagram of road circuits for complete signalling with "economy switching."
Fig. 21 is a diagram of road circuits for automatic block working.

Discussion.

Sir W. H. White, in presenting the thanks of the section to Mr. Boult, said he had seen the apparatus before, and he thought that no one who had seen the demonstration that day could feel otherwise than that it was a thoroughly workable thing if it was wanted, and the test to which Mr. Boult referred in the paper, of service on the Great Northern Railway, was a very severe one certainly.

Mr. Boult said that in those trials every likely severe condition had been undergone—fog, frost, snow, &c.

Mr. W. A. Price said he had been intimate with the mechanical construction ever since the beginning. At first he thought it too intricate to be of practical effect, looked at as a piece of electrical instrument making. All the experience he had had of it made it appear to him that it *was* of practical value. The parts had to move with very little force, but they were extremely simple; they were those commonly accepted in the best telegraph practice, which was a conspicuous success. The trying conditions on the Great Northern Railway seemed to exhaust all the obviously weak points of the system. The difficulties of the thing certainly were rather obvious at first sight, and the extent to which they were got over was not so clear, but anyone who knew as much about the inside of it as he had the pleasure of knowing, saw a better future in it than one could see from some promises of the kind. It was a very delicate thing, but he had every hope that Mr. Boult would make a success of it.

ELECTRICAL CHANGES ACCOMPANYING THE DISCHARGE OF THE RESPIRATORY CENTRE.

Report of the Committee, consisting of Dr. A. Waller (*Chairman*), Prof. E. Waymouth Reid (*Secretary*), Prof. F. Gotch, and Mr. J. S. Macdonald. (Drawn up by Mr. J. S. Macdonald.)

Further Examination of Changes in Phrenic Nerve and their comparison with Simultaneous State of Blood Pressure.

Section A.—September 14th.

The further prosecution of research has taken the form of an inquiry *into the nature of part (if any) played by alterations of blood pressure in the causation of electrical phenomena observed in the phrenic nerve.*

In a nerve well supplied with blood-vessels, and with a circulation preserved in such good condition as that noted in experiments, errors might be introduced by such alteration in several ways.

(*a*) By alteration of volume of blood and lymph in nerve, and so of conducting media external to electrically disturbed tissue.*

By such means a change, produced in the relative proportion of current derived through galvanometer circuit, might in records give rise to an apparent change of total current.

(*b*) By action of changes of blood pressure upon the walls of vessels or upon the flow of blood through them, setting up electromotive changes of entirely different origin from intrinsic changes in nervous tissue.

* Source of current of injury.

(*c*) By direct effect of alterations of circulation upon the nervous tissue itself, especially in nerve partially dried and cooled from exposure, giving rise to intrinsic alterations in current of injury by altering conditions of moisture, temperature, presence of waste products, &c., affecting its development.

There were considerations which made it improbable that such causes were at work in the production of current changes observed in phrenic nerves. Amongst these may be mentioned:—

1. The constancy of base line in tracings.

2. The character of the rhythmical oscillations, the first part of each of which bore evidence of being a true and negative variation; the second part, as observed both in galvanometer and electrometer, being due to return of instrument to rest at a rate determined by instrumental elasticity.

3. The observation that phenomena in phrenic ceased when blood pressure was still considerable, and the heart continued its beat.

It was indeed anticipated that the relation between circumstances was really in a reverse order. That the phenomena, being genuine indications of large discharges from respiratory centre, would probably, in their most extreme form, be accompanied by discharges of vasomotor centres leading to alterations of blood pressure; and not that such indirectly caused changes of blood pressure would declare themselves so obviously by indirect effects upon injury current of phrenic nerves.

It was, however, deemed advisable to satisfy any criticism upon presence of errors of this nature by as careful as possible an estimation of their value. To do this it did not seem necessary, or even advisable, to confine the research to direct experiments upon the phrenic nerve, as it was presumed that errors (such as were sought for) would affect the apparent changes in any nerve under similar conditions of experiment to a degree dependent upon the vascularity of the nerve and the maintenance of its blood supply.

Experimental means were obtained for the simultaneous record upon same travelling surface of the movements both of a galvanometer and of a blood-pressure manometer. In this way two curves were obtained, one of electrical changes in tissue experimented upon and one of blood pressure in general circulation, admitting of immediate contrast.

The nerves chosen for experiment were:—

(*a*) The central end of divided vagus.

(*b*) The peripheral end of divided vagus.

(*c*) The recurrent laryngeal.

In all these cases phenomena were found characteristic of each individual nerve and irrespective of state of blood pressure, which will be elsewhere described.

But in addition indications were obtained and records taken of a relation sometimes existing between change of blood pressure and change of demarcation current in nerve, a fall of pressure being accompanied by a fall of current, and a succeeding rise of pressure by an increase in current.

In such cases the parallelism of curves, when obtained, is of a crude description, the galvanometer record following the main trend of the blood-pressure record, but not responding to the finer variations. It is also thought that such parallel curves are best obtained at the end of an experiment, when the nerve has presumably suffered from exposure.

A somewhat similar comparison* has been made previously by other observers in the case of spinal nerves, in which the demarcation current was noticed as dependent upon the condition of animal.

A very remarkable variation from such observations was, however, several times obtained from the peripheral end of divided vagus, in which the relation between the curves was inverted; a rise of blood pressure being accompanied by a negative variation in demarcation current, a fall with an increase. There is also a marked difference in the nature of correspondence between the two curves from that previously related, in this case much more exact, finer changes being responded to and with a constant latency.

The possible presence of a double relation of demarcation current in the peripheral end of vagus to changes of blood pressure, one in the opposite direction to the other, was naturally the cause of a multiplicity of experiments made upon this stretch of nerve. It might be remarked that whilst the first type of change is analogous to that so far found in other nerves, this second is peculiar to the nerve in question; and although admitting of a simple explanation by the behaviour of the electromotive changes in the walls of blood-vessels contained in it, is not (for reasons to be elsewhere advanced) thought to be so caused.

In continuation of general research an attempt was made to differentiate between the secondary results of an altered circulation in nerve and the direct effects produced by changes in the blood-vessels contained in it.

For this purpose direct experiments of a similar kind were carried out upon large blood-vessels. An artery was ligatured and divided, the central end (towards the heart) dissected from its surroundings, raised in air, and connected with galvanometer in same manner as nerves had been connected. The stretching was found of importance, and the femoral artery first chosen was abandoned for the carotid, as free from branches and, therefore, from local injuries during dissection.

In such a preparation current changes are found proportional to changes of blood pressure of a gross kind and with a marked latency. The relation between two is of same kind as that found in the peripheral end of vagus nerve, a rise of pressure causing a fall of current. Such current changes are not due to alterations in resistance of tissue to any current found there, as their nature remains unaffected by the compensation or over-balancing of the demarcation current, retaining always the same direction whatever the direction of current traversing tissue may be.

As to the real source of such changes no positive statement can be made. The most probable cause would seem to be an alteration in tonus of muscular coat secondary to the change of pressure within vessel. This is supported by the result of one experiment, in which an otherwise uninjured carotid artery was separated from surrounding tissues by a thin sheet of india-rubber and a portion of its length connected with the galvanometer. The galvanometric curve bore at first no relation to the blood-pressure curve, but a relation was imperfectly introduced by injury to artery at electrode distal from heart. In other experiments attempts were also made to introduce electrodes into blood stream, but experiments were lost owing to coagulation of blood and the effects of pressure upon electrodes themselves. It is, however, felt that without further evidence an attempt to fix source of origin is futile.

It was thought that the general research might be assisted by a study of such changes as might be obtained under similar conditions from largest combination of nerve and artery to be obtained in body. Experiments were performed, in which the vagus and carotid, having been divided and ligatured at same place, were lifted up without being separated from one another. The piece of tissue so formed was stretched to its normal length, and its distal end connected to galvanometer in usual way.

From this preparation it was found possible to obtain, with unfailing regularity, a galvanometer curve having the most marked correspondence to simultaneous blood-pressure curve, a rise of pressure being accompanied by a negative variation of current.

It is to be noticed that the demarcation current obtained from this tissue was exceedingly small, and that the variations in it were of a magnitude bearing an extremely large ratio to it; in fact, the most successful comparisons were made in preparations in which the original current was practically nil. It is also of note that the quantity of change obtained from this preparation in response to a change of blood pressure is greater than that obtainable from carotid artery alone, and much greater than that obtainable from vagus nerve alone.

In the total result it seems possible that a contribution is due to artery, a portion to nerve, and that in this case the components have same direction; for ligature of nerve near to trunk and as far as possible from electrodes produced a diminution in the steepness of curve, and it is believed an alteration of its character.

The value of this latter observation is enhanced by the manner in which other changes unrelated to changes of blood pressure, but known from further research to occur in nerve during conditions of experiment, are swamped by the superposition of artery, it being presumed that value of derived circuit through galvanometer is rendered comparatively negligible by its relatively large resistance.

In cases of all previous part of research it may be said that the physiological continuity of tissue examined is essential.

Summing up, it may be said that all the experiments upon which statements have been based were carried out under the conditions of original experiments upon phrenic nerves; that is, that the experimental method used for obtaining the alterations of blood pressure* consisted of curarisation, artificial respiration, and intervals of its suspension.

This, though not a good method for the unravelling of secondary problems which have presented themselves, allows one to translate all the occurrences which have been found in other nerves and tissues to a probable occurrence during any one of phrenic experiments. The main results may be tabulated as follows:—

1. Current changes have been found in divided nerves directly proportional to changes of pressure, the relation between the two being, however, as to time and quantity of a gross kind.

2. Current changes have been found in peripheral end of divided vagus nerve *inversely* proportional to changes of blood pressure, in which relation is much more exact.

3. The latter class of changes has not been obtained from any other nerve examined;

4. but is constantly to be obtained from the divided carotid artery, though here less exact;

5. and with great exactness and magnitude from vagus carotid preparation.

6. That this latter result is diminished by ligature of vagus below point examined.

Having thus obtained information of events met with in other tissues, nerves, and blood-vessels, situated in near neighbourhood and obtaining their blood supply from very similar sources, experiments were resumed upon phrenic itself.

Simultaneous curves of electrical changes in phrenic and of general blood pressure show no correspondence of a kind to explain the characteristic phenomena obtained in phrenic nerve alone of all the nerves examined, and the large alterations of blood pressure which occur in every experiment cannot be even definitely said to constantly affect the base line of phrenic tracing.

To make the result more conclusive, simultaneous records were taken both of current changes in phrenic and in vague carotid preparation, which latter is known to repeat all the incidents of a blood-pressure curve.

The tracings obtained show the typical appearances of either curve, of quite diverse types, showing no relation of the kind sought for. Oscillations in one curve are unaccompanied by oscillations in the other, with an exception of no moment from point of view of question at issue.

It is worth stating that, as two galvanometers of same pattern but of different internal resistance were used in the latter class of experiment, care was taken to change the instrument connected to either tissue during the course of experiment. This, however, may be looked at as of considerable advantage, and serves to make result obtained more conclusive.

* Gotch and Horsley, Croonian Lectures, 1891.

* Chloroform anæsthesia was used.

The final statement may be therefore made with positive conviction:—"That the phenomena obtained in phrenic nerves are independent of, in the sense of being in no way due to, local changes of blood pressure or of circulation; neither in so far as such conditions affect the nerve nor the blood vessels contained in it."

This does not affirm the absence of circumstances analogous to those obtained elsewhere, but places them, when present, in a position of very minor importance.

ELECTRIC WIRING SYSTEMS.

By J. D. F. ANDREWS.

The appurtenances involved in electric light wiring installations have since the commencement of the industry been subject to such a diversity of treatment and conception, that even at the present advanced stage of the industry we have to look upon wiring as still in a state of development.

The aim of the writer during the past few years has been as far as possible to reduce the innumerable variety of devices into one systematic series of appliances, applicable to any of the chief methods of protecting the insulated conductors.

For this purpose it has been assumed that the most effective methods of protecting the insulated conductors are armouring with lead or with iron wires and conduits or tubes. There are several modifications of these main methods of protection, but in order to effect the objects that the writer has in view, he has only chosen those which it is most widely admitted possess the properties required in the respective methods to the greatest degree, namely, lead or iron wire for sheathing for twin or concentric wiring, and galvanised steel or brass tubing for twin wire and also concentric conduits.

In the concentric system of wiring are to be found features of such conspicuous superiority in all respects to those obtained in any modification of twin wiring that it would doubtless be in common use if it were not for the established regulations being specially drawn to suit twin wiring. In most cases no modification in the conditions of supply are necessary, and it is gratifying to note that several engineers have agreed to permit the introduction of concentric wiring in connection with their supply mains.

The concentric system of wiring possesses features so different from all others that it is not possible to retain all the advantages it possesses when confining it to a series of appliances designed for twin wiring; additional appliances have, therefore, been introduced into the series expressly for the concentric system.

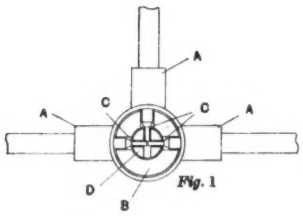


Fig. 1

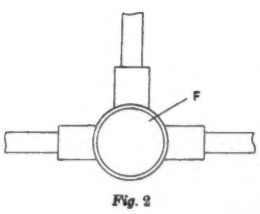


Fig. 2

The design of the accessories for electric light wiring is regulated by a few points of detail, which give a character to the construction of the series. Thus a system in which the joints are made by twisting and soldering, and insulating with rubber lapping, necessitates the construction of the appliances to suit this feature, including the cables which would require to have stranded conductors to comply with the amount of bending involved in this mode of jointing. Owing to the fact that this form of joint has hitherto been the most common, the construction of even the smallest cables or wires with strands has become general. A joint insulated with pure rubber lapping, which is a perishable article, requires to be done by specially reliable men, for, when once the joint has been made, it is not easy to ascertain the quality of its construction. This class of joint is also costly in point of labour. Soldering in connection with joints is considered an inconvenience, and devices have consequently been introduced with screw terminals as a substitution. The liability of screws to loosen is, however, too serious a danger to permit of such joints being hidden away in all parts of a building. In cases, however, where it is possible to dispose of these joints in groups in the form of terminal distribution centres, the method has advantages. With this exception, soldering has become recognised as the only effectual means of uniting metals for electrical purposes, and it must be regarded as an essential part of a reliable joint. The use of pure rubber for the insulation of joints in wires has always been acknowledged to be defective and providing a serious weakness in the system The vulcanisation of the innumerable joints in an installation, which would be a cure for the evil, has been found impracticable.

The aim, therefore, of the writer in devising his series of appliances has been to adapt porcelain in the joints to replace the insulation round the soldered junction. The conductors are not twisted together, and in none of the appurtenances are they subject to sharp bends. There is, therefore, no objection to using solid conductors for the smaller sizes, of which Nos. 18, 15, and 12 have been adopted by the writer for many years past, and no other sizes are arranged for beyond the distribution board, off which to take branches. Having decided upon the materials and principle of jointing, the next points for consideration in the construction are compactness and accessibility for

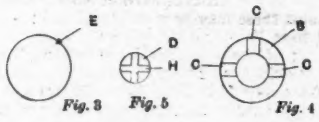


Fig. 3 Fig. 5 Fig. 4

inspection. In the concentric system the joints are more compact than for twin wiring, and the two necessarily differ slightly in construction, but the principle in both is the same.

The concentric joint is illustrated open in fig. 1, and closed in fig. 2, and figs. 3, 4, 5 illustrate those insulators and connector respectively.

The sheathing of lead or iron wires or the conduit tube is soldered into the trunnions, A, A, A. B is the porcelain insulator provided with recesses, C, C, C, in which the vulcanised insulation of the conductors rest; D is a brass conducting piece provided with recesses, or grooves, H, for the conductors, which are soldered in position; E is a porcelain disc placed over the joint, and upon this is a disc of metal a little smaller than a penny, which is soldered into the outer box of the joint. The time occupied to make this joint is about 12 minutes when there are several to make. It is applicable to both conduits and cables.

For twin wiring the joint is necessarily somewhat different in form but the same in principle. It consists of a metal box, figs. 6

Fig. 6.

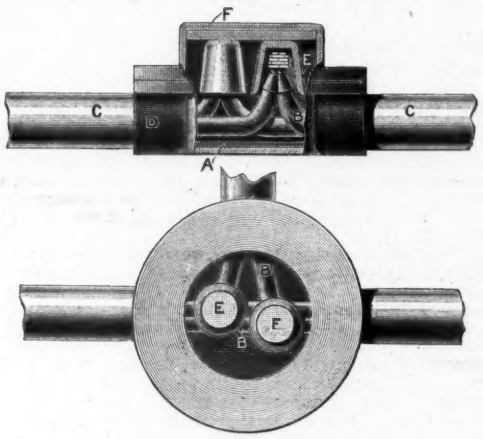


Fig. 7.

and 7, with a disc of porcelain, A, placed on the bottom. The armouring of the cables or tubes, C, is soldered into trunnions, and the inner conductors, B, extend inside and are bent towards the open side. The insulation is then removed from the ends sufficiently to be able to unite the respective ones together. This is done by binding them together with copper wire and soldering. A porcelain thimble, E, is then put over the united ends, and a metal cover, F, fixed on by screws over the whole, which may be made water-tight

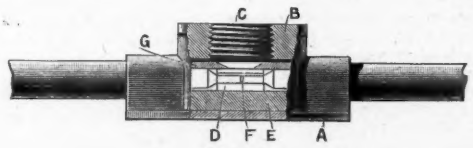


Fig. 8.

by either soldering or red lead between the flanges. This joint is equally well suited to conduit wiring. It has been used for concentric wiring with advantages, but it does not fulfil the functions for this purpose so well as the one specially designed. Nor is it so cheap.

In the case of conduits it is often necessary to provide openings in the length of tube to assist in drawing in, these would consist of boxes the same as the joint boxes but with a flat plate cover fixed on with screws instead of the recessed one. The conduits for use in connection with these boxes are of galvanised steel, usually $\frac{3}{8}$-inch outside diameter for concentric conductor 3/22 = No. 18, or 7/19 = No. 15, and $\frac{1}{2}$-inch outside tube for 7/19 = No. 12 or 7/17. Stranded conductors are preferable for conduits on account of their pliability for drawing in.

The larger sizes of tube are used to distribution boxes for feeders only, and no joints are required in them. Draw-in boxes are, how-

ever, sometimes required, for which galvanised cast-iron boxes are devised.

In this system it is important to note there is only one size of joint box or draw-in box in the network, beyond the distribution boards, the openings only are modified to suit the tubes or cables they are to take.

The outlets in the concentric system are necessarily somewhat different from those for the twin wiring, in order to preserve all the advantages the system offers. The principle of their construction is similar to the concentric joints, the same insulator being used, and the same junction for soldering in the central conductor. The outer case is provided with a flange, A (fig. 8), through which are holes by which to fix the outlet. The cover, B, is screwed into the box, and it may be soldered to finally fix it. It is provided with a ½ inch gas internal screw, C, in the centre, into which the nipple of the fitting to be carried is screwed. The junction, D, recessed in the china insulator, E, is provided with a thin brass disc, F, of the same diameter, which is soldered in position, and forms a fixed contact to connect with the spring contact in the fitting. A porcelain ring, G, is provided over the porcelain base insulator, and the hole in it is somewhat smaller than the contact.

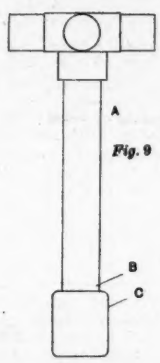


Fig. 9

FIG. 9.

These outlets are made two, three and four-way, and also backway. When the wiring is run under the flooring for lights in the rooms below, outlets are provided, consisting of a backway joint with an iron tube screwed into the backway. An insulator, with a fixed contact in it, is provided in the end of the tube, on to which is screwed a ½-inch gas thread coupling to carry the fitting. The contact in the tube is connected to the connector in the joint.

This form of extended outlet is used in cases where the cable is

FIG. 10.

required to pass on to another joint, or in cases where branches are to be taken off. When the extended outlet is to form a terminal to the wire, the joint at the top of it is dispensed with, and instead of it a nipple is provided into which the outer conductor is soldered, the central conductor being taken down to the contact in the end of the tube (fig. 10).

(To be continued.)

ELECTRIC WELDING.*

By R. F. DANFORTH, Superintendent International Traction Company, Buffalo.

Since the first carriage started on its trip on an ironclad roadway, the problem of maintaining joints has been an unsettled one. Within a decade we have made steady progress in the improvement of our roadway construction, having gone from a strap to a Richards rail, from the Richards to a 4-inch girder, then to 6-inch, and now to a 9-inch girder with its concrete base. Devices innumerable have been exploited to preserve the continuity of the roadway. Wedged joints and bolted joints have been found to be uncertain, and miles and miles of rail have been "scrapped" because the ends have become badly battered and the rail surface bent from lack of proper support at the joints.

The question has resolved itself into one of obtaining a practical method of securing a continuous rail by welding the lengths of rail together. Two well known methods have been followed, and it is the writer's desire to present one of these to you.

The Thomson Welding Company has for years successfully welded together pieces of iron and steel by use of electricity. The Johnson Company has taken up this process with a view of welding its girder rail into continuous lengths, in the street. Its first method of welding the abutting ends of rail by bringing the joint to a welding heat by the flow of an enormous current has been found to be a failure, because the homogeneity of the metal was destroyed. In the process of welding now being used in Buffalo, it has been the endeavour to follow as closely as possible the method employed in ordinary welding. After the metal is brought to a welding heat it is worked by being put under a pressure of about 35 tons, which has the same effect upon the material as the repeated blows of the blacksmith's hammer.

Under the former process of electric welding track joints the ends of the rails being together, the entire cross-section of the rail has to be brought to a welding heat. In the process now in use the ball of the rail seldom reaches more than a dull red. It is believed that the quality of the steel in the rail head is not injured by this low temperature.

In the true sense of the word, the abutting rails are not welded together, but the splice bars are welded to the web of the rail. These bars are of steel of the same quality as the rail, and measure 1 × 3 × 17 inches.

The weld is made at three points, the centre and ends of the bars. After the centre weld is made, the ends of the bars are welded. Each bar has in the centre a strip of steel pressed over the face, 1½ inches wide and ½-inch thick. The ends of the bar are drop forged, making a pear-shaped projection on the side, having an area of about 3½ square inches, and projecting ½-inch above the surface of the bar.

In order to obtain contact for the welder at the point opposite these end projections, a sheet of iron of the same shape as the projection is pressed into the depression on the back, which was made by forging the lug on the opposite side.

The process of making a weld on old rails is in general as follows: The pavement is removed for a space of 20 inches on either side of the rail and about 40 inches along the rail, and the material removed to the ties. The splice bars are taken off, and, if the bolt holes in the rail were punched, the holes are reamed out about 1½ inches or more to remove any check which may have resulted from punching the metal. The joint is then slightly crowned by driving a wedge between the rail and the tie. The three points to be welded are then cleaned by a sand blast. The bars are placed in position, resting on small wood blocks, and the contact points of the welder placed at the centre of the bars. By means of a hydraulic device, the jaws are brought together with about 14 tons pressure, and the current turned on and kept up one minute until the points of contact are brought nearly to a white heat; the pressure is then reduced to about 3½ tons, and at the end of another minute or less, the metal comes to a welding heat. The current is then shut off and the pressure increased to about 15 tons and kept on for one minute, or until the metal "sets." The end contacts are then welded in a manner similar to the method followed in the centre contacts, with the exception that the pressure, when the current is shut off, is raised to 35 tons and is kept on for two minutes. Under this pressure the bar is brought in its entire length in close contact with the web of the rail and the upset metal in the boss or projection disappears. After the weld is made the head of the rail is ground to a true surface by an emery grinder and is then complete.

The machines used in this process may be described as follows: The current from the line is passed through a railway booster, which raises the pressure to 500 volts. (This booster is not used where the initial voltage can be maintained at 500 or over.) This direct current at 500 volts is then used to drive a rotary transformer generating alternating current at 300 volts. This in turn is reduced to five volts in a static transformer; the secondary circuit consists of a single loop of copper and its ends form the contact points which are brought to bear against the bars.

It is found that at 500 volts the current required is about 250 amperes. The current flowing through the weld at five volts is about 30,000 amperes alternating. With this current flowing through the low pressure secondary circuit, it is found necessary to cool the contacts by circulating water around them.

An ingenious cooling device is used to reduce the temperature of the water so used. A tank is provided upon the top of the welding car, containing coils of pipe through which the water flows. These coils lie close together and the tank is filled with water. Air is forced through the water from a coil lying in the bottom of the tank through perforations in the coil. The evaporation from this cooling tank is found to be 47 gallons in 12 hours.

The welder proper is in the form of a rectangle, the lower portion of which is hinged so that the parts may be moved back and forth in the plane of the rectangle. On the upper portion there is a transformer coil, the primary of which consists of many turns of wire, the secondary being the rectangle above mentioned. This is a solid bar of copper, 4½ × 7½ inches in cross-section. The hinges in the two sides are spherical contacts. Around the outside of this rectangle is a steel frame of horse-shoe form, having at the upper end a modified hydraulic jack. The movement of the piston in the cylinder back and forth moves the lower jaws of the contact points. A varying pressure can be placed on the material grasped between the jaws. The pressure is measured by a pressure gauge, placed in a convenient position. The joints in the secondary circuit, the contact points and the transformer itself, are cooled by a flow of water.

The sand blast is obtained by blowing sand, by means of compressed air, through a flexible hose. The air is compressed by a motor-driven compressor.

The emery grinder previously referred to consists of an ingeniously designed carriage, supporting in its centre the emery wheel, and running on two rollers, which are moved back and forth on the surface of the rail to be ground. Its action is similar to a carpenter's

* Paper read before the New York Street Railway Association.

jack plane. The depth of cut made by the emery wheel is governed by means of a regulating screw, which raises and lowers the emery wheel. The wheel is driven by a belt from a collar motor mounted on the car.

Welds can be made as described at the rate of a joint every 13 minutes. It is found that the machine will average four joints an hour without any difficulty. In Buffalo the line voltage has averaged 410 and the current required about 375 amperes.

You probably ask why we decided to use the welded joint? The reply is that we find that the welded joint not only solves the problem of maintaining a continuous rail, but also of the best return circuit. The carrying capacity of the bars as welded is greater than that of the rail itself; there is no opportunity for electrolytic action between two dissimilar metals; there are no expanded contacts to work loose and no added investment for copper.

Another question frequently asked is, "What do you do about expansion and contraction of your rail?" This is solved in two ways. First, by placing an expansion joint every 2,000 feet; second, by leaving the bolted joints at the special work.

The reason for doing the latter is found in the method of construction used in Buffalo. When the rail is laid in concrete it is firmly gripped its entire length by this mass of material. The weak points in the rail or in its concrete base are bound to be developed. If there is any tendency for the rail to contract, the movement will be greatest where the pressure upon the rail is least. The rail is liable to break under the great tension at this point. The chances are very small for this movement being near enough an expansion joint to have that joint save the rail. If the rail breaks, a regular expansion joint can be easily placed at the break. In following years the expansion and contraction of the rail will be taken up at that point. In order to thoroughly test this question, track has been laid in Buffalo, both with and without expansion joints. The coming winter will solve the problem.

The effect upon a piece of old track, of welding the joints, is most satisfactory. In one instance we welded 6,000 feet of 6-inch girder rail, which had been in use since 1891, and whose surface was so badly bent and battered that it was thought to be well-nigh useless. The rail had been originally laid on chairs with special two-tie joints. We removed the chairs and relaid the track in its proper position, but with low joints. After the pavement was in place (except at the joints) we brought the rail ends up by shims. After the welds were made and the shims removed, the track was found to be in fine condition. After this experience, we welded our track first and resurfaced and relined it afterwards.

The cooling of the weld depresses the joints about $\frac{1}{4}$th inch. We therefore raise the joints to allow for this depression. The old rail in question is considerably worn under the head as well as upon the ball of the rail, and it would therefore be difficult to fit loose splice bars or other mechanical joints so as to obtain a tight fit. The welded bars maintain the joint in its position and make that portion of the rail stronger than any other part.

The cost of welded joints is not materially more than that of the bolted joint with ample bonding. The same result may be obtained with cast-welded joint mechanically, but it is doubtful whether the cast-welded joint gives as good electric contact as the method described.

At the end of another year the Buffalo Railway Company will be able to present interesting data upon the saving in coal resulting from a perfect return circuit. The work of this year has been largely done with the intent to furnish an ample return circuit to the power stations. As the work progresses, a marked saving is shown in the economy of the station.

The *Street Railway Review* in publishing the above paper gives the following brief notes of the discussion:—

Mr. M. G. Starrett, of New York City, asked the author what experience he had had in Buffalo with effect of change in temperature on the electric welds, also did the raising of the temperature of the steel in the ends of the rails in the welding process have any effect on the structure of the steel. Mr. Danforth replied that as far as his experience went, out of 3,100 welds, 17 had broken, and these failures were due to defects in manufacture. In the work they are now doing in Buffalo they do not expect 1 per cent. of the joints to break during the coming winter, and they have the maker's guarantee to that effect. So far two joints have broken in Buffalo. The heating of the rail in welding has no noticeable effect on the steel. Mr. W. B. Reed, of New York City, asked if the joint is found to be as rigid as the rail itself. Mr. Danforth answered that after repeated testing with falling weights at various heights they had been unable to break a single joint at the joint.

The president called on Mr. Nicholl for his experience with electric welding. He replied that his company had done no work of this kind, but was considering the advisability of electrically welding its joints.

WATER-TUBE BOILERS IN THE MERCANTILE MARINE.

An anonymous correspondent of the *Times* seeks to justify the water-tube boiler policy of the Admiralty by a piece of special pleading on behalf of Messrs. Wilson, of Hull, who have fitted eight ships with the Babcock and Wilcox boilers. The author is not very happy in his facts. Water-tube boilers are claimed as essential for the Navy, because they can be safely forced. Yet when Messrs. Wilson have attempted to get additional power by forced draught, they have in each case damaged the water-tube boilers. Further, the Belleville boilers so rashly introduced in the Navy, and so extravagant in fuel, are an entirely different boiler from the type used by Messrs. Wilson, so that even had this firm's experience been quite satisfactory, nothing would have been settled thereby of any comparative value for the Navy. One of Messrs. Wilson's ships, the *Tasso*, is cited as illustrating the advantages of the water-tube type. On six voyages made, first with ordinary boilers, and next with water-tube boilers, the vessel performed as follows:—

	Ordinary.	Water-tube.
Total distance	9,472 knots.	9,200 knots.
Total coal	1,072 tons.	981 tons.
Average speed... ...	11·45 knots.	12·05 knots.
Coal per voyage ...	178½ tons.	163½ tons.

Now, what do these figures show? The writer says that, figuring out the speeds, it means a total coal saved of 130 tons. But this is misleading. The old boilers ran 9,472 knots, with a ratio of knots to coal per voyage of 5·3; the new boilers with a ratio of 5·63. This is in favour of the new boilers. But the old boilers had been at work since 1890, and the boilers had become defective and troublesome, and the new boilers carried 210 lbs. pressure against 160 lbs. of the old boilers. Quite apart from the question of boilers, the figures produced may be taken as a good basis on which to found an argument for higher pressure steam. But the facts advanced say nothing favourable to putting Belleville boilers in war vessels, boilers which have proved wasteful in the Navy, on the Newhaven and Dieppe service, and on the ss. *Kherson*. The old style of boiler is girded at because, if it lasts 20 years, it has little of its original matter but the shell left in its composition. But does not M. Bertin, of the French Navy, say the same as this of water-tube boilers with, however, a much shorter period of years? Six years seems an outside life for water-tube naval boilers. We are told a good deal about the comparative smokelessness of the *Tasso* when using Yorkshire coal, but we are not told that the boilers have, or have not, a special form of furnace. Either they have this special form of furnace, or the boilers did smoke with Yorkshire coal. Generally, this *Times* correspondent has omitted essential technicalities, and does not appear qualified to speak technically. To praise Mr. Wilson for supporting the rash procedure of the Admiralty seems a little out of place. Why, if Mr. Wilson wished to be so very consistent, did he not himself employ the Belleville boiler, so well tested for us all by the Admiralty, in place of employing an entirely different and non-comparable form of water-tube boiler?

Something much more definite is required to satisfy engineers that the policy of the Admiralty is sound. The issue is quite confused by this letter in the *Times*. There is no comparison between torpedo boat practice and line of battle ship practice, yet this writer speaks as though the *Powerful's* boilers were replicas in type of the boilers of torpedo vessels, whereas there is nothing common between them except the unfortunate name water-tube.

TRAIN LIGHTING IN TUNNELS.

On the occasion of a recent visit to Glasgow, the writer came across two very excellent examples of how *not* to do it, in the direction of lighting trains and carriages when running in or through tunnels.

The first of these was the Glasgow and District Subway, which, as most of our readers will remember, is an underground circular line, double track, with two tunnels side by side, about 6 miles long, running at various depths below the surface, but averaging perhaps about 30 or 40 feet, and therefore for the most part keeping under the streets. It is worked by cable, and has a dozen or more stations, with platforms reached by means of staircases from the streets. There is a fine big power house on the south side of the circle, containing two massive horizontal engines, each of about 1,500 H.P., and either of which is capable of driving the whole system through the regular kind of cable driving gear.

No serious trouble can be said to have arisen from the cable working; every now and then, however, an automatic grip release fails to act, or some other such incident occurs, and one, or both, lines may be stopped for a few minutes or for a few hours; but the same kind of breakdown might readily occur in an electric line, and on that score, therefore, one need not just now find fault with cable working *per se*.

When, however, the traveller buys his ticket, and goes downstairs to take a subway train, which usually consists of a motor or grip car for ordinary passengers, and a smaller trail car behind for those who want to smoke and spit (and they all do that), he is tempted to wonder whether the management of the line is in league with all the opticians of the country to create serious eye trouble.

As a rule, the trains each carry and burn half-a-dozen ordinary oil lamps, which give a dim, religious, but fairly regular light. Each car, however, is also fitted with half-a-dozen or so electric lights, which vary in candle-

power perhaps from that of the proverbial red-hot hairpin to just short of bursting point, and all within the merest fraction of a second. As for the voltage, the lamps appear to be intended for a pressure of 110 volts, but if so, it must range from nearly zero to 120 or 130.

On inquiry as to the probable cause, the explanation given by one local man was that the company had had a lot of trouble with its electric mains, owing to dampness in the tunnels, which, it may be explained, are of brick, and not of cast-iron, like the London electric undergrounds. The current for lighting stations and rolling stock, it should have been stated, comes from the cable power house, and is, for the latter purpose, led into a couple of iron T-shaped conductors carried on insulators and pins fastened into the tunnel walls at, or near, the level of the eaves of the cars. Contact with the cars is made by means of a sort of double trolley or sliding contact at the front end of the car, which gives a fine pyrotechnic display as the car moves along.

Dampness in the tunnels might account, by leakage, for the car-lamp pressure dropping below normal, but not for the intensely rapid variations in the voltage and candle-power which make it almost impossible to read, or even to use the eyes at all, when in the cars. Of course, the method of collecting current is to blame, and no other result need have been expected from attaching the trolley contact to the car just at a point where its side motion, or oscillations, would be greatest.

This criticism was met by the statement that the tunnels are so small, and the rolling stock so close fitting (though only on a 4-foot gauge), that it is quite impossible to have the contact on top of the car, and the use of a cable for driving—with its attendant pulleys, &c.—prevents a third rail being employed for the electric contact.

Of course, it might be replied that electric traction had better be substituted for the noisy and ever-dangerous cable; the mere thought of seeing a reckless, drunken man, on one of the station platforms a yard or two away from the exposed running cable, is enough to give one a nightmare; but since it is claimed that the working expenses of cable driving are much less than those of electric traction could possibly be, then the next obvious thing to do is to put in a small regulating battery on each train. Or if that is considered too costly, why not use a system of train electric lighting like that adopted on the Brighton and so many other lines, or else dispense with electricity altogether in favour of compressed gas?

Nothing could appear worse than the oil lamps and absurd attempts at electric lighting now in vogue, and no electrical engineer could see the latter without a blush of shame to think that such things can be done in the name of electricity.

It may, by the way, be noted that at the recent annual general meeting of this Subway Company, the question of electric working was again raised by shareholders, and it is probably raised still oftener by the general public. Granted that cable driving may give a lower percentage of expenses to receipts, the greater popularity of electric working, due to its quietness and flexibility, might yet so increase the total receipts by inducing more passengers to travel, that the net results would be no worse, but perhaps even better, than at present.

It is, however, rather a timorous shirking of the problem for the chairman to say—as he is reported to have done—that "one of their greatest misfortunes had been in connection with their electricity, but they would again go into the matter." The directors should do it at once, with a bold front, and not fear that because they may have had a defective electrical arrangement in one direction, therefore they had better keep clear of electricity altogether.

The second instance of ingenuity misapplied may be found on the local line of the North British Railway, which runs east and west through Glasgow, and for three or four miles under cover. Of course, for such a comparatively short run, even though comprising as many stations as miles, and one very important station—Queen Street—it could hardly be expected that the rolling stock should be provided with gas, or other such lamps, kept lighted all day long, just for the 10 or 15 minutes occupied in traversing the city each time the train passes.

An attempt, therefore, has been made to use electricity as a suitable means of providing light, and here one sees the same sort of infantile effort to give light as on the subway. A couple of small candle-powered lamps are put into each compartment, and at times, when the train is stationary, the light is not much below half the normal. When running, however, one sees the same painful flickering from "nothing" up to "not much;" and the reading of a paper, or practical use of the eyes at all, is quite impossible. Yet here the absence of a cable has given opportunity for a third rail, from which the current is taken; but a broad disc or wheel is employed at the rear of each train to pick up the current, and the fitness of such an arrangement, considering the rust and dirt which must inevitably gather on the third rail, would be questioned (one might suppose) by the veriest tyro.

What is wanted is either a brush contact, which would, of course, spark and soon wear out, or else a sliding contact like that used on the Liverpool Overhead Railway; but better still, to employ the Stone system, or a similar method of using the train's energy to generate and store up electric energy to be switched on when required by the guard or other responsible person on the train; or it might even be done automatically.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

18,759. "Improvements in disconnecting boxes for electric and other cables." C. C. Fowler and The Reason Manufacturing Company, Limited. Dated September 18th.

18,768. "Improvements in the means of enclosing wires for use in connection with electrical installations." A. Normanton and R. O'Brien. Dated September 18th.

18,769. "A new or improved arrangement in conjunction with telephoning." H. Salmon. Dated September 18th.

18,744. "An automatic gravity electric fuse replacer." J. R. Craig, Jun., and A. M. Owler. Dated September 18th.

18,776. "A new or improved arrangement of driving mechanism for connecting electro-motors to machinery." G. J. Gibbs. Dated September 18th.

18,797. "Improvements in method and means for simultaneous electric telegraphy and telephony." C. A. Randall. Dated September 18th.

18,811. "Improvements in conduits for electric conductors." J. J. Bate Dated September 18th.

18,868. "An improved dynamo." M. H. Hurrell. Dated September 19th.

18,870. "Improved manufacture of insulating material." A. J. Boult. (J. Jungbluth, Germany.) Dated September 19th. (Complete.)

18,891. "Improvements in instruments for use in measuring electrical resistances and currents." F. H. Elkington. Dated September 19th.

18,892. "Improvements in electrical 'damping' apparatus." G. W. Johnson. (Hartmann & Braun, Germany.) Dated September 19th.

18,904. "Improvements in the method of and means for preventing electric sparking at contacts in circuits, including electro-magnet coils or other coils or conductors in which a self-inductive or sparking capacity exists." W. L. Wise. (C. L. Buckingham, United States.) Dated September 19th.

18,910. "Improvements in electricity meters." H. L. P. Boot. Dated September 20th.

18,953 "Improvements in electric motor vehicles." H. Leitner. Dated September 20th.

18,962. "Improvements in telephone registering apparatus." O. Linke-Graf and J. Gmuer-Benz. Dated September 20th. (Complete.)

18,968. "Improvements in or relating to electric incandescent lamps." W. P. Thompson. (A. Sinding-Larsen, Norway.) Dated September 20th. (Complete.)

18,972. "Improvements in switches for electric lamps." J. Hunter. Dated September 20th.

18,980. "Improvements in telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated September 20th.

18,989. "Improvements in automatic devices for use in connection with motor starting and regulating switches." W. J. Spikins and A. H. Mayes. Dated September 21st.

18,996. "Improvement in apparatus for telegraphing." H. W. C. Cox. Dated September 21st.

19,020. "Improvement in electric arc lamps." T. Wilby. Dated September 21st.

19,026. "A new or improved electro-magnetic brake for cycles, motor cars, and other wheeled vehicles." A. E. Patrick. Dated September 21st.

19,031. "Improvements in driving and steering gear for electrically-propelled motor vehicles." E. Kuhlstein and J. Vollmer. Dated September 21st. (Complete.)

19,035. "An electro-chemical method of disintegrating rocks carrying minerals." C. H. Logan. Dated September 21st.

19,065. "Improvements in and in the manufacture of the balance weight fittings of electric lamps." R. F. Hall. Dated September 22nd.

19,103. "Improvements in telephone conductors or cables." The Joint Stock Company (styled Kabelwerk Rheydt, and J. Zappe, and A. Hohnholz). Dated September 23nd.

19,105. "Improvements in secondary batteries." P. A. Chalas. Dated September 2nd.

19,124. "Improvements in electric thermostat." J. E. Spagnoletti. Dated September 23nd.

19,148. "An electric pull switch." C. I. Cummins. Dated September 23rd.

19,169. "Means and apparatus for electrically working vacuum and air pressure railway brakes." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated September 23rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

143. "Improvements in electric arc lamps." W. J. Davy and G. Thomas-Davies. Dated January 3rd, 1898. Relates to clutch arc lamps with enclosed arcs in section. The frame of a lamp consists of an externally ribbed dome, an insulator, a central tube, a chamber made in two parts and screwed together, and two rods depending from this chamber to support an open yoke, not shown. An insulator supports an outer casing. An outer globe is supported by a nut and screw on a cross-bar, which rests in notches in the yoke. The inner globe and lower carbon are carried by a holder on a spring in the cross-bar. The upper carbon is inserted in a guide which slides in an inner tube, movable vertically in the tube; the guide has a conical top carrying balls to maintain electrical connection with the inner tube. The upper carbon passes between two jaws carried by pairs of links, which are pivoted together and hung by other links from a collar and disc on the end of the inner tube, so that when they are lifted from the bottom of the chamber they grip and lift the carbon. The inner tube is linked to a dash-pot which is hung by cords from pulleys carried by the tube, the outer ends of the cords being attached to a sliding ring; this supports a U-shaped core above two series coils, and a similar core below two shunt coils, carried by the tube. The piston of the dash-pot is supported by this tube. Series resistance or impedance coil is held between the dome and a lining. A cut-out is provided consisting of a horse-shoe electro-magnet situated above an armature, which is pivoted upon the top of the chamber and is thus in electrical connection with one terminal of the lamp. The magnet core is connected electrically through the coil on it with the other terminal of the lamp. The action of the shunt regulating coils may cause their core to lift the cut-out armature into contact with its electro-magnet, which then maintains this contact, short-circuiting the lamp. 4 claims.

156. "Improvements in the method of fixing and suspending bare electric conductors." A. B. Blackburn and N. H. White. Dated January 3rd, 1898. Bare conductors such as those employed in electric railways and tramways are supported by clips attached to pivoted insulators. An insulated conductor in the form of horns is mounted over the insulator and is connected to the earth return circuit. Snugs are formed on the ends of the clip, and on the breakage of the wire make contact with one or other of the horns so as to short-circuit the generator and fuse which is at once broken. Guy wires may take the place of the snugs, the horns being suitably modified, or a loop of wire may pass over a metal plate, as a substitute for the horns, and be drawn into contact therewith on breakage of the wire. 2 claims.

462. "Improvements in or connected with electric mains." G. H. Nisbett. Dated January 7th, 1898. Relates to conduits or mains for electric conductors are formed of glazed earthenware, &c., made in sections, and are arranged to contain either bare or lightly insulated or armoured conductors of any pattern. The troughing is of rectangular or circular outer section, and is closed by a lid. The troughing is preferably rounded on its lower inner surface, and is provided with either fixed or movable bridge pieces on which the conductor rests. The remaining space is preferably, but not necessarily, filled with bituminous material. The troughs may fit together by various patterns of jointing, and the lids are cemented into position. One or more cables are placed in each trough. The ends of the sections may be chamfered for ease in making branches. 3 claims.

1899.

1,024. "Improvements in dynamometrical apparatus." H. Bouron. Dated January 16th, 1899. Relates to calculators of the work absorbed by a transmitting shaft in motion and consists in replacing the usual balance springs by hydraulic balances. One modification consists of a reservoir filled with water communicating with a manometer and closed by an elastic and impermeable membrane attached to the reservoir by means of a bridle in which a block can slide. This block bears evenly on the whole surface of the membrane left free in the interior of the bridle. 1 claim.

2,726. "Improvements in electrical measuring instruments." J. W. Flower and T. E. Gambrell. Dated February 7th, 1899. Relates to measuring instruments of the d'Arsonval type. Consists in the use of a coil very thin in proportion to its other dimensions, enabling the poles of the magnets to be brought very close together thus producing an intense magnetic field. 2 claims.

3,233. "Improvements in conduits for cables for carrying electric currents." L. Bolknap and A. Sundh. Dated February 14th, 1899. Relates to the protective case employed for protecting the cable from fire, water, and wear. Consists of a flexible rubber tube and flexible metallic armour in the case. 8 claims.

3,717. "Improvements in 'switch throwers' for steering electric tramcars and the like." O. Ward, jun. Dated February 20th, 1899. Consists of a shaft located below the platform of the car and journalled thereto. A foot lever in movable connection with said shaft, and located slightly above the floor of the platform a spring for holding the foot lever in an elevated position, a thrower which co-operates with the ordinary switch forming a part of the track, and hinged to one end of the shaft a hand lever pivoted to the dashboard of the platform and projecting through the platform, and suitable connection between said thrower and lever. 1 claim.

4,276. "Improvements in automatic potential regulators for dynamos." N. Browne. (The Tirrill Automatic Potential Regulator Company, United States.) Dated February 27th, 1899. Refers to 1,535 of 1889. Consists in a combination with the solenoid coils, their core and the lever having specially constructed contact points of a subjacent spring bearing a contact point and a clamping support made adjustable to grasp the spring at different points, so as to vary its range of vibrations. 7 claims.

4,774. "An improved electrical cut-out or fuse." F. W. Heaton and H. Smith. Dated March 4th, 1899. Relates to an improved method of insulating the terminals of cut-outs. The cut-out is made entirely of porcelain, and the fuse is bent round in the form of an M, and a V-shaped cavity is made to receive the V portion of the M. 4 claims.

5,111. "A new or improved electrically operated gas tap and apparatus for lighting at a distance." G. Schunemann and O. Rieder. Dated March 8th, 1899. Consists of a gas tap in connection with an apparatus which lights the escaping gas, both operated by electricity. The tap is worked through the medium of an electro-magnet, lever and pawl, and ratchet wheel, and an electric spark causes the gas to light. 4 claims.

5,180. "Improvements in telephone switchboards." J. M. Overshiner. Dated March 9th, 1899. Relates to the construction of the switch and drop device. Consists mainly in the combination of a jack, a drop, a latch for the drop, and an electro-magnet for controlling the latch, of contact arms secured to the respective sides of the jacks, one of which is included in circuit with the coils of the electro-magnet a spring arm placed near each side of the jack, and having buttons on their free ends whereby to permit them to be forced against the contact arms, one of the spring arms being included in a listening circuit and the other spring arm being included in a signal circuit, the latter spring arm being adapted to move the operating contact arm so as to open circuit the magnet coil when the signal circuit is closed. 22 claims.

5,217. "Improved construction of commutators for dynamos and electromotors." J. Burke. Dated March 10th, 1899. Consists in giving the commutator bars an angular or curved cross-section, so that each single bar is held in position by the adjacent bars on each side of it. 1 claim.

5,572. "Improvements in insulators for carrying electric line wires." G. Hulistrung. Dated March 14th, 1899. The insulator consists of two sections, one of which is more or less hollow and adapted to be connected to the screw of the spike or bolt by which the same may be attached to a wall or other surface, the upper portion of which is provided with a neck which has a male thread formed thereon, and in the neck is formed transversally a straight irregular zig-zag or otherwise undulatory passage through which the line wire is passed. The latter being gripped by means of an internally threaded cap forming the second section. 4 claims.

5,941. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated March 18th, 1899. Relates to electric lights. The filament is made of an incandescing body composed of a material which is a non-conductor at ordinary temperatures, but becomes conducting only at high temperatures. A heating device is therefor provided which, when it has heated the filament sufficiently, stops heating. 8 claims.

6,024. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th, 1899. Consists of a lamp with an illuminating body composed of electrolytes for non-automatic excitation, a box inserted in the usual holders in combination with a globe fixed directly to the holding ring. 3 claims.

6,025. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th, 1899. Relates to improvements in electric lamps with second class conductors. Consists of a base which carries the illuminating body and of a lampholder for receiving the base and in the form of a switch lampholder. 1 claim.

6,026. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th 1899. Consists of a lamp with illuminating bodies made of second class conductors, the distinguishing feature of which is that of the three pairs of contacts between the base and the lamp-holder, two are formed as sliding or sliding spring contacts, spring piston contacts, or bayonet catches, for the purpose of securing a simple and cheap connection. 1 claim.

6,028. "Process for the production of electrical resistances with small heating capacity." V. J. Feeny. (Allgemeine Elektricitats-Gesellschaft, Germany.) Dated March 20th, 1899. Relates to the heating of resistances. Consists in reducing to a minimum the insulating bearer or core for the conducting material by winding the wire on rods having thin sides made of insulating material. 2 claims.

6,157. "Improvements in electric arc lamps." W. C. Johnson and A. Wunderlich. Dated March 21st, 1899. Relates to Specification 4,231, 1899. A choking coil is substituted for the resistance coil. Two lateral solenoids are substituted for one in the above specification. 2 claims.

6,213. "Improvements in insulating lining for electrical apparatus and process of making same." The British Thomson-Houston Co., Ltd. (G. B. Painter, United States.) Dated March 22nd, 1899. Relates to that class of electrical apparatus in which a metallic shell surrounds other metallic parts serving to carry an electric current. Consists in forming a single lining made of one piece and of a means of working insulating material. 6 claims.

6,270. "Improvements in combined electrical switches and lampholders." R. F. Hall. Dated March 23rd, 1899. Relates to electric lampholders. Consists in the employment of a movable or rotating block of non-conducting material having directed through it a pair of separated metallic conductors which are adapted to be brought in line with upper and lower sets of plungers or contact pieces to make the circuit and out of line with such contacts to break the circuit. 2 claims.

6,300. "Improvements in apparatus for electro-plating." H. Bockmann. Dated March 23rd, 1899. Relates to an improved apparatus for electro-plating small articles in large quantities. Consists of a rotary shaft within a tank, and in electrical contact with the negative pole of a battery, and carrying two or more adjustable discs or wheels. 3 claims.

6,347. "Improvements in electric brakes for railway and tramway vehicles." W. L. Wise. (The Action Gesellschaft Elektricitats-werke, vorm V. L. Kummer and Co., Germany.) Dated March 23rd, 1899. Relates to an electric brake for electric railway and tramway vehicles. The brake bands or blocks are applied by means of one or more electro-magnets energised by the short circuit current of the motor, whilst for emergency the same brake bands or blocks are applied by spring or weight force which is operated when the trailer is separated from the motor vehicle. 4 claims.

6,420. "Improvements relating to electrical resistance boxes and like apparatus, and to switches therefor." C. T. Gambrell and T. E. Gambrell. Dated March 24th, 1899. Relates to electrical resistance boxes and like apparatus. Chiefly consists in the use of a conducting bar arranged in proximity to each series of fixed contact pieces and provided with a sliding contact block which can be brought into engagement with either of the fixed contact pieces. 8 claims.

6,443. "An improved pocket galvanometer." C. Beez. Dated March 25th, 1899. Relates to pocket galvanometers. Consists in an improved contact carrier, one of which is secured to the galvanometer by a conducting cord while the other is detachable. 2 claims.

6,478. "Improvements in electric arc lamps." R. F. Hall. Dated March 25th, 1899. Relates to the feed mechanism of arc lamps and is worked on the principle of an Archemedian screw. 3 claims.

6,510. "Differential hot wire voltmeter." A. M. Clark. (Hartmann & Braun, Germany.) Dated March 25th, 1899. Consists in measuring by means of the compensation of different tensions of elastic wires as produced by an electric current or currents. 1 claim.

6,562. "Improvements in or relating to current regulators for electric batteries." M. E. Fuld. Dated March 27th, 1899. Relates to current regulators for electro-medical batteries. Consists of a regulator capable of gradually varying the current from a very small to as large a one as the patient can endure. 2 claims.

6,582. "Electrical furnace with peripheral heating by means of electrical resistances." D. Lunce, R. L. E. de Bourgade, and L. Schmitz. Dated March 27th, 1899. (Date applied for under Sec. 103, Act 1883, August 29th, 1898, being date of application in France.) Consists of a chamber of annular form containing two compartments, (1) a supply chamber enclosing fragments of porcelain capable of dividing the current of gas; (2) a reaction chamber heated over its entire periphery by means of conducting wires. 1 claim.

6,647. "Improvements in wall plugs for electric lighting and heating." A. P. Lundberg and G. C. Lundberg. Dated March 28th, 1899. Relates to wall plugs and connections of the two-pin type. Consists in split contact pins which fit on wedges enclosed in tubes thus making a tight connection. 1 claim.

6,684. "Improvements in carbons for electric arc lamps." D. Bacon. Dated March 28th, 1899. Consists in an electric arc lamp carbon having a longitudinal groove extending inwardly as far as the circumferential line of the crater or arc, but not to the axis or centre of the carbon. 1 claim.

6,883. "Improvements in apparatus for the production of silent electric discharges." M. Otto. Dated March 30th, 1899. Relates to 11,010, 1897. Consists of movable separating discs having alternately conducting and insulating sectors for the purpose of giving successive startings and interruptions. 1 claim.

7,883. "Improvements in means for supplying current to electrically propelled vehicles." W. H. Wheatley. (D. G. Stoughton, United States.) Dated April 14th, 1899. Relates especially to trams and railway vehicles with a line conductor midway between the rails. Consists of an enclosed electric line conductor, automatically operating covering leaves, a wheel electrode, a leaf opener adapted to precede the wheel electrode and leaf opener. 9 claims.

7,886. "Improvements in apparatus for producing electric sparks." H. H. Lake. (A. R. Shattuck, United States.) Dated April 14th, 1899. Relates to the ignition of gas by electric sparks. The spark is produced by means of an induction coil having in the circuit a simple commutator. 1 claim.